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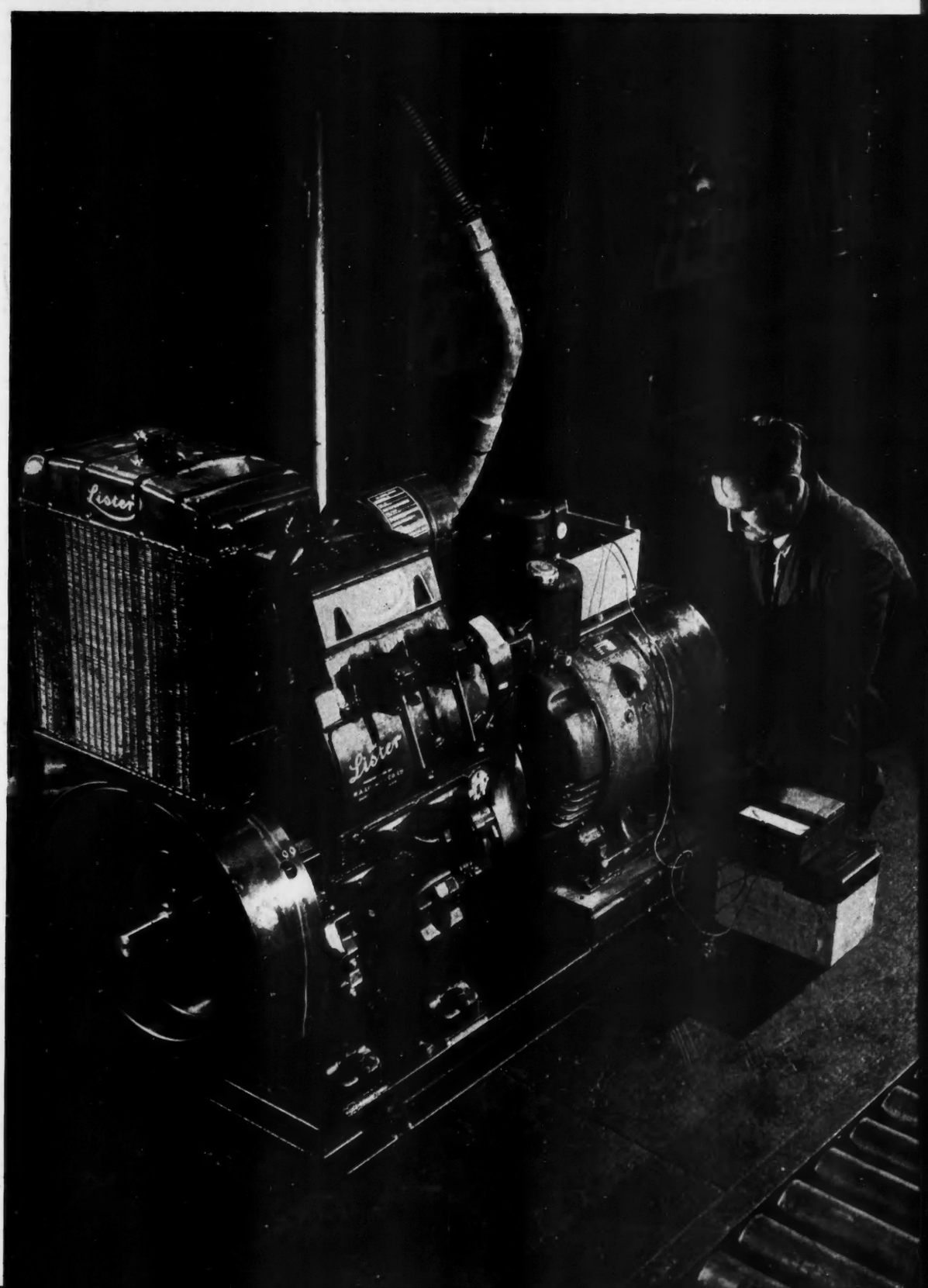

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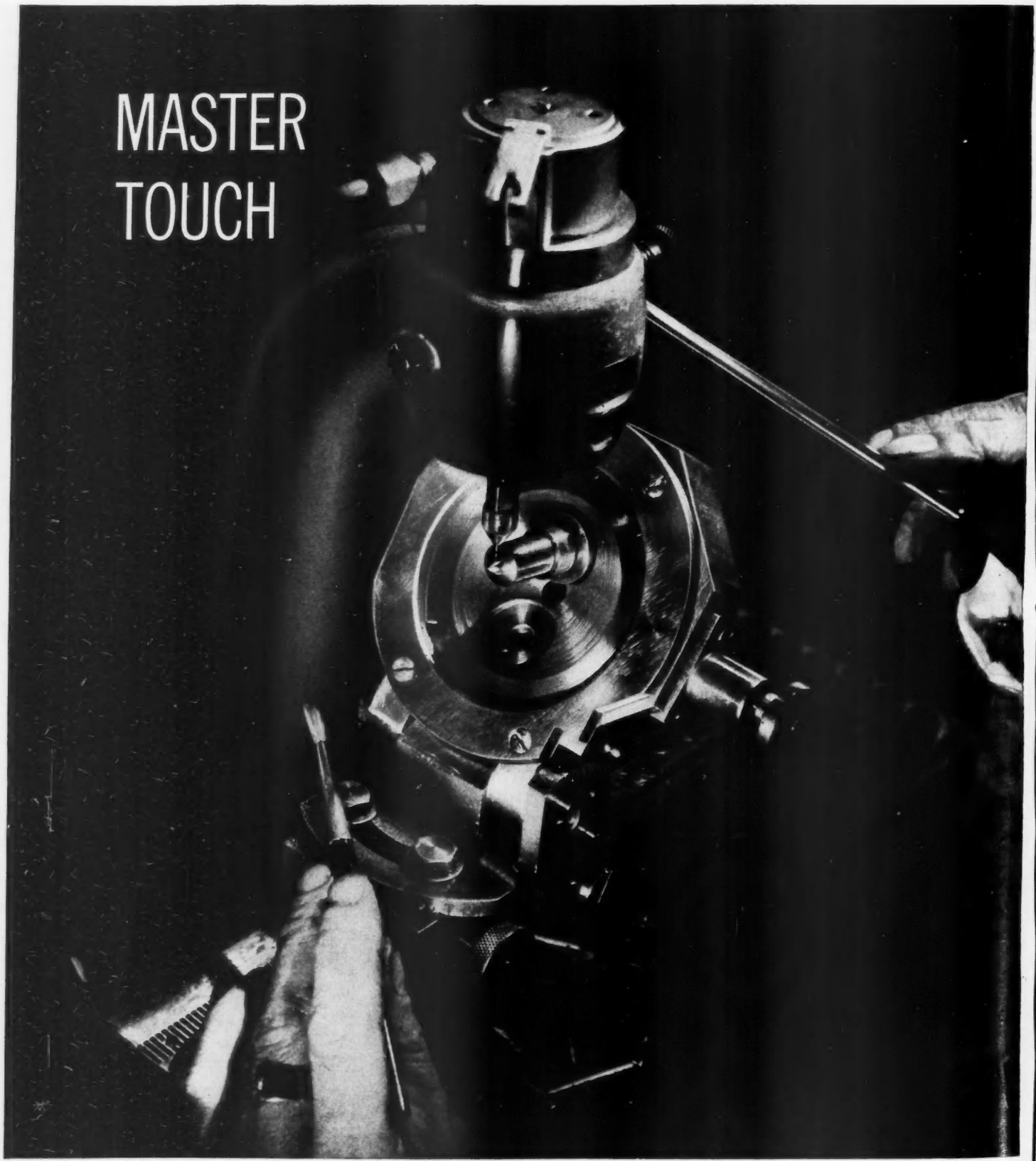

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AP 189

ENGINEERING Impact

of the Lighter Side of Farnborough

As a rule, the aircraft which steal the show at the Farnborough Air Display are the biggest, the fastest or the weirdest that have come into being since the previous show. This year's sensation was undoubtedly the HP 115 slim-delta supersonic research aircraft, but perhaps a significant part of the show was something which heralded the renaissance of British light aviation.

Earlier, some of the neat little Beagle aircraft took their bow. Intended for business and executive flying, they adopt a new principle: motor-car thinking for aeroplanes. As Mr. Peter Masefield, managing director of Beagle, has said, the light aircraft industry has progressed little since the days of the dH Moth and the Miles Hawk.

Beagle's confidence in their own future with the type of aircraft they are offering is stimulating. Why has private flying for business purposes taken so long to catch on?

In the 1930's flying for business was the province of the few, who used what airlines there were. A war and three decades have changed all that and the number of sorties flown by business men using the airlines has multiplied enormously.

Light aircraft, if they are to join in this growth, must have low initial cost, be economical to operate, have full airline standards of comfort, and be capable of flying in all weathers day and night. Beagle's aircraft match up to this specification and are good looking into the bargain.

Charter flying could also expand, given the right kind of light aircraft. There is a parallel between present day charter flying and the orthodox London taxi. Can the new light aircraft become the Minicabs of the air?

Geographical Location of a Works

Instead of emancipating man from control by his environment, technical advancement often works the other way, appreciably narrowing the variety of locations in which the more advanced manufacturing techniques may be practised. This was the thesis of Professor S. H. Beaver's presidential address to the Geography Section of the British Association.

To make his point that industries are faced with an ever intensifying geographical control over location, Professor Beaver traced the development of the mineral working and mineral using industries. From pre-Industrial Revolution days of the wide distribution of the iron industry, the first limitation on location came with smelting by coke, then came steel-making with even more restricting requirements, and now the modern fully integrated works, increasingly dependent on foreign ores, can only be built economically on a mere handful of sites.

Professor Beaver, who is at the University College of North Staffordshire, also traced parallel arguments for the electrical power industry, observing that power stations now require enormous quantities of cooling water and sites for dumping pulverized fuel ash.

He said all human activity took place in an environment which has three major aspects: the physical, the technical and the economic. Each of these aspects was subject to change—though the first was the most stable—and each would vary in its importance according to the nature of the activity.

Somewhat counter to his own arguments, Professor Beaver observed that the automobile industry had become "footloose." It was no longer tied to a pool of highly skilled labour in the Midlands, but as an automated assembly industry was attracted to sources of semi-skilled labour and the port facilities of London, Merseyside, Glasgow and South Wales. Even though these changes did not fully support the thesis of an intensified geographical control over location, he found that they supported the contention that technical advancement materially alters geographical values.

Helping Delinquent Firms

The prosperity of the United Kingdom depends mainly on the progressiveness of the 10 million people engaged in the 60,000 establishments in the country's manufacturing industries. Industries and firms which are not expanding —introducing new processes, increasing their share of the markets—are frequently labelled "unprogressive," and in spite of exhortations seem unable to change their ways for the better.

The position of these unprogressives in industry was examined in a paper by Mr. M. Zvegintzov given to the Economic Section of the British Association. He suggested remedies for their attitudes. Mr. Zvegintzov is currently engaged in long term planning for the National Research Development Corporation. As a preliminary, however, he observed that some sectors of industry or firms are backward and incapable of change, and these must be left for the normal process of competition to eliminate them, but such elimination can do only good in releasing manpower for redeployment—essential for a continual rise in living standards.

Mr. Zvegintzov described the craft-based tradition as perhaps the most important single factor in Britain today, because quality captures and holds markets and the penalty of failure is all the greater bacause of loss of goodwill. The problem was to translate valuable craft tradition and experience into a modern scientific idiom, by providing the craftsman with modern and delicate tools which will enhance his craft, not destroy it. This, he said, was as much a question of technical ingenuity as of education—for craftsmen and management alike.

A second difficulty, particularly in smaller firms with a more rigid management hierarchy, is resistance to new ideas, especially from the outside, because of the subconscious fear that they somehow cause loss of face and undermine authority. Mr. Zvegintzov ended with a warning. Progressive management could not be taught, and an *ad hoc* educational effort could not supply the answer because a generation hence the problems would be different. A policy of enlightened favouritism—presumably by the Government—towards the enterprising was to be recommended in the expectation that the success of the progressives would stimulate the others.

of the Shipbuilding Unions' Worst Enemies

There is more to the report of the British productivity team on their visit to Swedish shipyards than their suggestion that the employers and unions should set up a joint committee to "investigate the whole question of utilization of man-power in the shipbuilding industry" in Britain.

Standardization is probably the biggest factor in the success of Swedish shipyards, apart from their harmonious labour relations. None of the yards visited by the team was interested in inquiries for passenger vessels. They specialize in cargo vessels, and this specialization has promoted the development of standard ship designs. Often, a standard vessel can be quoted for and accepted by an owner at lower cost and in preference to a custom-built ship. Has this policy also helped the workers to appreciate the managerial concept of productivity, and thus bring about an improved identity of interests between management and labour? The team make no comment on this point.

Constructional methods in Swedish yards do not vary materially from United Kingdom practice. In fact, "a tendency exists to regard Britain as the leader in technical matters." But standardization creeps in again: notable variations from UK practice were found in the more extensive use of standardization of parts and miscellaneous fittings.

On the use of the optical projection system for cutting plates, the team report that one of the most up-to-date yards had not introduced it and do not intend to do so. Another company had used the system in one yard but had reverted to the conventional system for a new yard they had built.

Though discussions are in progress as a result of the team's suggestion, there is no outward sign yet that the unions are prepared to streamline their own structure. There are too many water-tight compartments in the unions —the boilermakers alone have five. In the face of mounting unemployment in shipbuilding areas, the unions are their own worst enemies.

Supermarket Selling

If supermarkets go on increasing at the present rate, the time will shortly arrive when the retail tail will wag the manufacturing dog, especially over price maintenance. More supermarkets could actually enforce the outlawing of retail price maintenance if they became sufficiently powerful. The manufacturers' answer might be to form into ever larger units and a condition could be reached with a very delicate balance of power—the irresistible mass meeting the immovable object.

This is the essence of a forecast made by Mr. N. Stacey, economic and marketing adviser to the General Electric Company, speaking at the B.A.

The manufacturer has another method of self-protection (and one that is recommended by military text-books), namely direct attack by setting up his own retailing establishments. By becoming his own middleman he has a greater margin to combat competitive price cutting, but his range of products must be wide enough to make such a venture an economic success. Boot's, the chemists, have done it for years.

The supermarket lends itself to a high degree of mechanization, though it may be many years before the fully automatic shop is attained. Perhaps the nearest is the one designed by Solartron-John Brown in which the customer walks before samples of the goods on sale, takes a disc numbered to correspond to the item selected, and finally gives all the discs to the cashier. The latter then dials through to the store room where the goods are automatically dispensed, and by the time the customer has finished paying, the complete parcel is delivered at the desk ready wrapped.

There is already a store in Toronto, Canada, which operates on a similar system, selling spare parts and materials for cars, motor-cycles, cycles, etc.

Brainy Brains

In the mine of information and ideas which the British Association annually opens up, it was the President of the Economics Section, Professor C. F. Carter, who this year pointed to the largest untapped seam—"The economic use of brains."

The engineering industries are perhaps the largest users of brainy brains. They are certainly the most important nationally since they are the producers of our material wealth. The concept of material wealth seems to be the starting point of Professor Carter's argument. "This country," he says, "is heavily populated, and not well endowed with natural resources other than its people; its ability to maintain a high standard of living and to earn the necessary large sums by exporting to a highly competitive world depends above all on the effective use of brains."

There has been too much talk about intellectual "labour", leaving out the idiosyncratic balance of individual development. For optimum use of these scarce resources of "effective intelligence" we should have to regard them as an economic problem: more needs to be known about their supply, best use and distribution.

A vocation is often no more than a haphazard follow-through of an ill-informed school-day fancy; paper qualifications are often confused with high ability; and often a man of ability succeeds in spite of his education.

The shortage of the higher forms of ability is a shortage of men who are capable of dealing with *new* and *unexpected* tasks within a certain range, and who are not confined within too narrow a specialization, Professor Carter said.

One important aspect of the subject is being surveyed by the British Institute of Management. To their members they have sent out a questionnaire on the selection methods used by British firms. The form covers management, and technical and specialist employees, as well as operatives and clerical grades.

Showing the World Britain's Aircraft

Britain's aircraft industry presents to the world a large and varied range of aircraft. Some of those shown at Farnborough and others currently building are described.

THE large scale amalgamations which have taken place in the aircraft industry over the last few years have not resulted in any reduction in the number of exhibitors at the SBAC Flying Display and Exhibition at RAE, Farnborough. On the contrary, this year's exhibition building is the largest ever erected for an aeronautical display and the number of stands and exhibits is more than ever before.

Entry of the Lightweights

One of the most obvious newcomers since last year's show is Britain's new aviation group—Beagle. Considering they did not exist at the time of last year's show—they were formed in October 1960—it is a remarkable achievement to have taken part in the Flying Display with four aircraft.

The newest and most interesting of these is the twin-engined B 206. The basic parameters were defined by Mr. Peter Masefield some 15 months ago when he was managing director of Bristol Aircraft Limited. After an exhaustive market study it was obvious that a large market existed for a light twin-engined aircraft for executive purposes. The result is seen in the B 206. It is basically a five-seat aircraft but other arrangements are available giving different seating layouts up to seven seats and also as an ambulance version. The cruising speed is about 200 mph.

Powered by two Rolls-Royce Continental 10-470A engines of 260 bhp, the B206 has a maximum payload of nearly 1,000 lb which it can carry for 1,150 miles at an economical cruising speed of 228 mph. These figures, taken together with the fact that the B206 can clear 50 ft in a zero-wind take-off distance at 685 yd should give it a strong appeal to the executive aircraft market. The provisional UK price is something under £30,000.

The Beagle A 109 Airedale which first flew in April of this year, has a single Lycoming 180 bhp engine at present, but later will have a Rolls-Royce engine. Having four seats, the cabin is more akin to that of a car. The aircraft is said to be comfortable and quiet and has been specifically designed to give fatigue-free journeys of some length. It is equipped for day and night operation. A high cruising speed (about 140 mph) and a long range ability (650 miles, or 1,050 with long-range fuel tanks) gives the Airedale a combination of desirable qualities, including the price of £4,750.

The Beagle A 61 Terrier—which Beagle say buyers are " queuing up for "—sells in the UK, for £1,995. It is in fact a civil development of the well known military Auster Mk Six. Having a dH Gipsy Major engine of 145 bhp, the Terrier is simple to maintain, cheap to operate and has a good performance. Maximum speed and range are 110 mph and 415 miles respectively. It seats three people and is said to be remarkably quiet. It should prove popular with flying clubs and is capable of being a glider-tug.

The AOP Mk Eleven is a development of the Auster Mk 9. It has STOL capability, taking off in zero wind in 92 yards and landing in 187 yards.

Beagle B 206 seats 5/7 people.

Beagle A 109 Airedale for fatigue-free travel.

Beagle A 61 Terrier costs under £2,000.

VTOL and Supersonic

The fact that participation by two of today's most interesting aircraft, the Hawker P 1127 and the Handley Page 115, was uncertain, is an indication of the sense of urgency behind their respective test programmes in the vertical take-off and supersonic research fields.

The P 1127 strike fighter last March successfully made conventional take-offs, in addition to its earlier VTOL and hovering flights. The test programme continues at present in the development of transition from vertical hovering to forward flight. Britain's other well known VTOL aircraft the Short SC1 is an old hand at Farnborough and once again showed its capabilities. Although intended purely for research, the experience acquired by Short's has enabled the company to prepare a number of designs of VTOL aircraft, both military and civil.

The giant Hawker Siddeley group have 56 Armstrong Whitworth military freighter/transports on order from the RAF. With its four Rolls-Royce Dart engines it can haul a payload of 29,000 lb for 500 nautical miles or 20,000 lb for 1,200 nautical miles. Civil Argosies are basically the same but instead of having a back opening door for dropping supplies as the military version has they have doors at both ends. The civil Argosy, in service with an American airline is, after only seven months of operation, achieving over 10 hours per day utilization and will shortly be pushed up to 13 hours per day.

The RAF have 56 Armstrong Whitworth Argosy freighter/transport aircraft on order.

Hawker P1127 VTOL strike fighter.

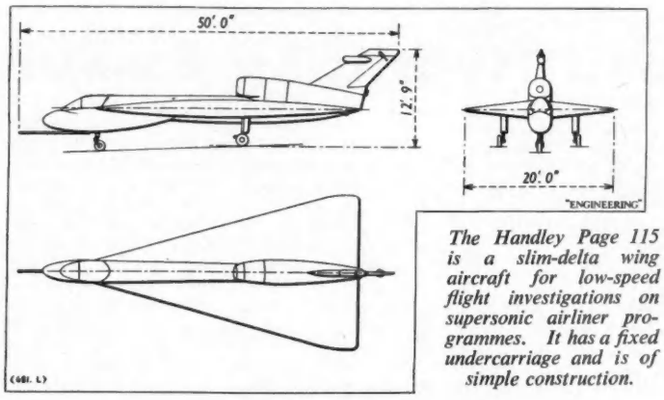
The 600 mph dH Trident the first of which recently rolled out of its hanger, is designed for economical operation on short-haul routes. It is powered by three rear-mounted Rolls-Royce Spey by-pass engines. Fitted with auto-flare/auto-landing equipment for low visibility approaches and touch-downs, the Trident has been ordered in quantity by BEA who hope to put it into service during 1963.

de Havilland's are not allowing their competitors to have all their own way in producing aircraft for executive travel. The Jet Dragon, powered by two rear-mounted Bristol Siddeley Viper 20 jets will cruise at 500 mph. It is being built as a private venture as a natural successor to the dH Dove piston engined aircraft which has sold world-wide in large numbers.

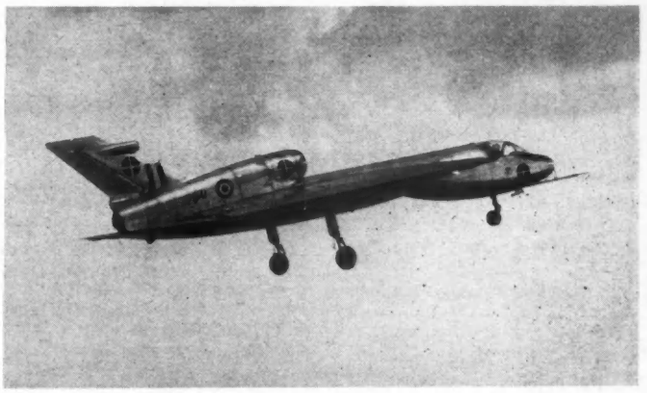
The Avro 748, scheduled to go into service this year, is a short-to-medium range 40/44 seat airliner. Proving flights will be done by Skyways Coach-Air Limited. This aircraft has been designed to operate from airfields of limited runway length and is specially suited for airports of high altitude and high temperatures.

The Potent V Bomber

The Avro Vulcan B2, one of Britain's pride of V bombers, is now equipped with four Bristol Siddeley Olympus 301 engines making it one of the world's most potent four-engined aircraft. Each engine develops a thrust of 20,000 lb. In squadron service with the RAF, the Vulcan B2 is equipped to carry the Avro Blue Steel air-to-ground stand-off bomb.



The Handley Page 115 is a slim-delta wing aircraft for low-speed flight investigations on supersonic airliner programmes. It has a fixed undercarriage and is of simple construction.



As mentioned previously, the Handley Page 115 delta-wing supersonic research aircraft is now on trials. Although designed for low-speed flight tests, this aircraft will play a very important part in British supersonic airliner programmes. It is the first slim-delta wing aircraft of the type now accepted as the best planform for the Mach 2·2 airliner to give full scale experience. Whilst only 50 ft long 20 ft wide, and apparently simple in construction, the HP 115 will bring in a new phase in aerodynamics. Only about one fifth of the linear size of slim-delta supersonic projects, its rates of response and oscillation will be very high compared with a full scale aircraft.

The Handley Page Victor V bomber is claimed by the makers as being the largest aircraft as yet to have reached the sound barrier. The B2 version, more powerful and refined than the B1, also in service with the RAF, has Rolls-Royce Conway engines each developing 17,250 lb thrust, and a wider wing span. Thus range and high altitude performance have been increased. Like the Vulcan B2, the Victor B2 can carry the Blue Steel bomb.

VC 10 Next Year

The British Aircraft Corporation are making good progress with their Vickers VC10 "big jet" airliner. Orders for 52 have so far been placed and the first fuselage was moved from its assembly jig at Weybridge last May. It has four rear-mounted Rolls-Royce Conway engines each developing 22,500 lb thrust (for the Super version). Due to fly next year, it should steal the next Farnborough Show, as it is a bigger aircraft than the Boeing 707. In spite of its size it is extremely agile and the design philosophy has been based on an airfield performance superior to any comparable jet airliner. This is mainly due to the excellent lift characteristics of the large uncluttered wing due to placing the engines aft.

The BAC One-Eleven announced in May of this year as a direct successor to the successful Viscount, is now in production at the Corporation's factories at Weybridge, Luton, Filton and Hurn. Adopting rear-mounting for its two Rolls-Royce Spey engines, the One-Eleven has a maximum cruising speed of 540 mph. Full passenger complement with baggage is 57 at 500 mph, for stages of 800 statute miles. The initial order for ten came from an independent airline, British United Airlines, who have an option on five more.

The Bristol 188 all-steel research aircraft was hoped to have shown itself at this year's show, its first flight is imminent however. Powered by two 14,000 lb thrust dH Gyron Junior DJG 10 turbojets, the Bristol 188 was designed for sustained flight at well over Mach 2·5 to allow study of the mal problems on the airframe, engines and components. Entirely new techniques of fabrication have been evolved for the stainless steel structure which will have a maximum service temperature of 500°C. The arrangement of the engines about half way along the wings allows for ready modifications to the engine air intake arrangements.

The Short SC 5/31 Belfast swing-nose transport aircraft was announced last May. Capable of flying the North Atlantic non-stop with a 100,000 lb payload, Short's believe that an aircraft designed for specialized container traffic will be more effective with a swinging nose, since this allows the full volume of the aircraft to be loaded in one operation.

The SC 5/31 has two floors. The main or lower floor is of very light construction and carries three roller ways for pallet loading. On the side of the fuselage about 6 ft up are two longitudinal lines of rollers into which the second layer could be inserted. Instead of confining itself to all freight, the SC 5/31 can carry 55,000 lb of freight on the lower floor and 138 passengers and full amenities on the upper. A military version of the Belfast is now being built for the RAF.

Helicopter Range

Westland Aircraft, with their helicopter monopoly cover a range of rotary wing aircraft weighing from 5,000 to nearly 60,000 lb. They claim that such a range meets all the helicopter requirements to be found in the world. Westland were among the pioneers in the application of turbine power to helicopters and already in this class they have in production the Wessex I and II, Gnome, Whirlwind, Belvedere and the Scout.

The Belvedere has tandem rotors and is powered by two Napier Gazelle free-turbine engines of 1,650 shp each. The transmission design allows both rotors to be driven by either engine if the other fails. In this event, the changeover to single-engine operation is completely automatic and takes only two seconds. Good single-engine performance allows the Belvedere to return to base and make normal landings in completely safety, whatever its all-up weight.

Baby of the Westland fleet is the Scout. Carrying 5/6 people, this general purpose helicopter is powered by a Blackburn Nimbus free-turbine engine rated at 885 shp. It combines small dimensions, excellent payload/performance characteristics, good manoeuvrability and operational versatility.

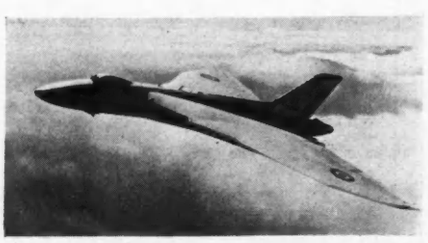
Ground Effect Machines

Hovercraft—the vehicles which no one can quite decide where they belong—were shown in model form by several of the companies undertaking their development. Westland had a large scale model of the SRN 2 which is scheduled to have its first "flight" in the spring of next year and will be used for operational research. It weighs 27 tons and can carry 66 passengers at 70 knots. The layout consists of two large fans and two reverse pitch propellers. The fans supply pressurized air for lift and the propellers drive the craft and enable it to manoeuvre.

Britten-Norman, pressing on with their own Cushioncraft, had models of the CC-1 and CC-2 displayed. The CC-1 was designed and built in seven months and proved reasonably easy to drive; it is stable and hovers at a height of 15 in. During this week, Britten-Norman announced that the CC-2 had just had its first trial flight. It has been designed as a commercial proposition and they hope to sell them at a price well under £20,000. The CC-2 can seat ten persons and is powered by a Rolls-Royce V8 petrol engine.

Such a range of airliners, military and light aircraft, helicopters, VTOL and research aircraft, not to mention the component manufacturers, show that the British aircraft industry is extremely versatile and very much alive.

Westland Belvedere tandem rotor helicopter.



Avro Vulcan B2 (left) and Handley Page Victor B2 can both carry the Blue Steel stand-off bomb.

The Scout: smallest of the Westland range.

Oil Well Rig Uses Piped Hydraulic Power

A rig to be used for servicing oil wells is undergoing trials in the UK as a drilling rig. It is driven by hydraulic power—with the prime mover 200 feet from the well head.

AFTER three years' development work with hydraulic transmissions, BP Exploration Company are now testing a drive unit which runs on piped hydraulic power at their South Leverton oilfield in Nottinghamshire.

Mr. Harrison, the drilling development engineer with BP who worked out this idea, said during the trials that it was hoped to expand the concept of hydraulic drives to full-scale well-head drilling rigs. The idea, Mr. Harrison told ENGINEERING, was to find a power source with the advantages of steam which made use of diesel prime movers.

In oil well drilling rigs and workover rigs (usually the latter are smaller versions of drilling rigs used for servicing wells already drilled by the main rig) steam has no fire risk and the boiler can be situated several hundred feet away from the drawworks and other equipment at the borehole. The advent of diesels, although in other respects desirable, brought with it the need to place these prime movers on extended platforms right alongside the borehole. Now the use of " piped " hydraulic power is analogous to a return to steam (or electricity without the attendant fire risk) in that it allows the efficient and cheaply run diesels to be removed from the well-head.

Weight and Noise Reduced

As could be seen in the South Leverton installation, this reduces the weight load on the drilling platform to about a quarter the normal figure and the noise level at this position is also greatly reduced. Mr. Harrison considers that this development could lead to lighter platforms with considerable financial saving.

The hydraulic units at South Leverton are so quiet at the drilling position that the greatest observable noise is that generated by the final chain drive to the rotating table. This could be eliminated, of course, and BP already have a drilling table unit at an advanced stage with a direct drive from hydraulic motor to rotating table.

The unit, shown diagrammatically, will be needed on an off-shore drilling platform at Abu Dhabi in the Persian Gulf by next March. The maximum horsepower of 400 (excluding the mud pump) suits it for workover operations on oil wells at this site since they required a greater horsepower of 3,000 for the actual drilling. In South Leverton, the lower power is sufficient to drill potential oil-yielding wells at least down to the anticipated 4,000 ft. The design of this smaller rig is similar to that of a large scale rig and it will be reasonably straightforward to scale up the unit if this first trial unit is successful. The larger hydraulic units are already available.

In detail design the unit is very simple. Other than the mud pump driven by its own Paxman diesel (normally run as a separate unit and required at Abu Dhabi in this form) the other circuit is a straight hydraulic pump-hydraulic motor circuit such as has been used for moving ships and aircrafts gun turrets. The hydraulic units are duplicated so that breakdown of one does not entail total stoppage.

The two variable displacement hydraulic pumps are generally intended to be run at a constant speed of 950 rpm and variation of their swash plate angles between 0 and 25 degrees from a position in the driller's position can vary their volume and pressure output to suit the load. The horsepower output of the diesel is automatically controlled to give the power selected at the drilling table.

At South Leverton, the bore-hole was about 3,500 ft deep at the end of August and the power requirement for drilling was only about 50 hp at this depth. With the present set-up this meant that one of the Paxman diesels was working at only one-eighth its capacity since BP were not using the optional compound coupling on to the mud pump drive (see diagram).

Great advantages would be gained if the next unit had the mud pump itself driven hydraulically from the same circuit, as all the drive horsepower not required for the rotating table and drawworks could then be diverted into it. This is important because, although drilling can be performed with a low mud pumping speed, it is always best to keep this at the maximum for the equipment and power available. Hydraulic drive would allow this with simple control by diverting only as much hydraulic fluid to the rotating table and drawworks as was absolutely essential.

Mobile Drilling Rigs

The whole concept of hydraulic power piping would be admirable for developing mobile trailer-mounted drilling rigs with the diesel prime movers on one unit and the hydraulic motors and mud pump on another. In this way the diesel prime mover could be run at full power, with the power being shared as outlined above.

The South Leverton outfit was developed in association with Oil Well Engineering of Cheadle Heath, and it is worth noting that the hydraulic pumps and motors are made by Von Roll, the Swiss engineering firm (see the table for such plant details). None of sufficient size is known to be made in the UK.

At Abu Dhabi, the hydraulic line will be 200 ft long and will consist of 4 in steel piping and 3½ in bore flexible rotary hose. This is considered about the maximum leng h for efficient use.

Cost was said to be about the same as that needed for a conventional outfit of similar power driven directly by diesels, as the hydraulic equipment had only replaced (with regard to cost) parts of the drive and torque convertor equipment normally needed.

General Specification

Engines
Two Davey-Paxman 12RPHW/111, 400 shp at 1,250 rpm. Equipped with fluid coupling, size 29, Type SCR3.

Hydraulic Pumps
Two Von Roll Type 50-PEH, variable displacement rated at 200 cont. hp at 950 rpm, 3,500 lb per sq. in maximum working pressure. (Imported into UK by Hydraulic Installation Limited.)

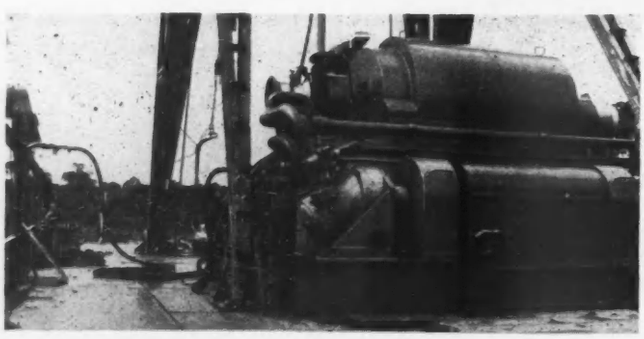
Drawworks
Oweco-National Type T-32-5, rated at 400 input hp.

Hydraulic Motors
Two Von Roll Type 50C, fixed angle, rated at 200 cont. hp at 950 rpm. (Imported into UK by Hydraulic Installation Limited.)

Hydraulic Controls
Keelavite Hydraulic control gear, actuated by air from driller's position.

Mud Pump
National Type C-250, 7¼ × 15 in, rated at 370 input hp at 65 strokes per minute.

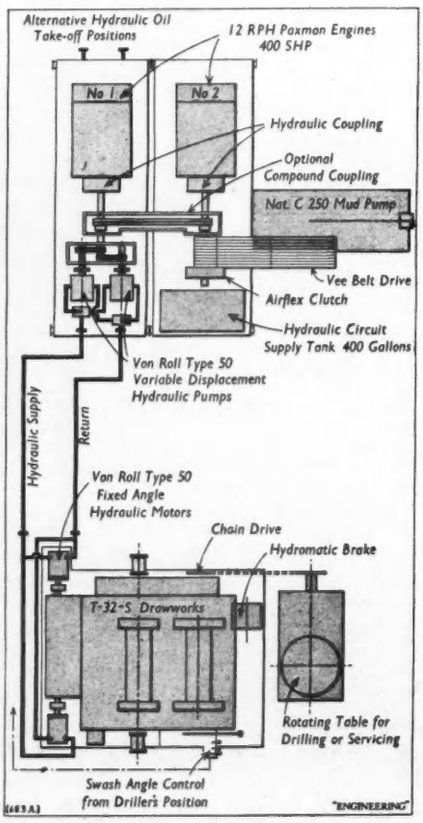
Rotary Hose
Hewitt-Robins, Super-Monarch, 3½ in bore, 5,000 lb per sq. in working.



(Above) One of the continuous 200 hp motors powering the drawworks.

(Left) The empty space behind the drawworks normally occupied by the prime movers is illustrated in this general view of the rig floor.

Use of a hydraulic circuit allows the diesel engines to be remote from the drawworks and rotating table.



Plain Words

By Capricorn

AT A recent exhibition of children's art, one of the pictures, surprisingly, showed a motor-car in the foreground. I say surprisingly because very, very few adult artists would include a car in a painting. The picture was called " The city at night," and depicted a street scene—some old cottages, a church and several factory chimneys in the background, and people walking along the pavement in groups. Only a child, innocent of the conventions of contemporary artists, would have painted such a natural and familiar scene, placing a beetle-like car in a prominent position.

Cars are in fact prominent in street scenes today. Because they move, they tend to be more prominent than houses or shops. Yet a future art historian will find little evidence of this when he examines the paintings of the 20th Century. I hope someone is making a collection of children's pictures—a collection that will be valuable two or three generations hence because it will present a vision of the world uninhibited by the self-consciousness, the inhibitions, the blind spots and the antipathies of our tortured artists.

I can think of two reasons why they are so shy of motor-cars and other *objects de l'ingénieur*. The first and most powerful is that when they are studying at art school they cherish the ambition to live wholly on their art and yet be true to their conception of real art. They know that there are only 30 painters who make their living in England by selling pictures, without having to paint portraits or posters. And they also believe that most of these 30 have had to compromise their artistic consciences in order to achieve fame as well as promise.

To the art student, the devil who takes him up into a high mountain and tempts him with all the kingdoms of the world is an advertising agent who wants him to take up commercial art, to paint pictures of cranes or washing machines—or motor-cars.

The other reason, I believe, is that they are desperately afraid of producing " coloured photographs." Ever since the camera was invented, artists have regarded photography as competition. It is high time they disillusioned themselves. The walls of houses today are not crowded with pictures as they used to be, but if you go into middle-class homes you won't find photographs, except a few of the children on the lid of the piano or on occasional tables. You will find paintings—or, to be precise, reproductions of paintings, mostly the old masters or the French Impressionists. Our contemporary artists have missed the boat.

Please understand that I am not concerned with the beauty, or lack of beauty, of motor-cars—even supposing we could agree on the meaning of beauty. I am arguing simply that artists today are false to their calling. They are turning a blind eye to the contemporary, mechanized scene. It surely cannot be too static for them?

Letters to the Editor

Success and Frustration

SIR, I do not disagree with Capricorn's remarks in Plain Words on a too-early choice of career, but I do suspect his concept of success (ENGNG., 25 Aug. '61, p. 229).

He refers to the men in middle life who decide that they have *only* average ability—but, of course, these men in general have average ability, for what else does the word average mean? Success in this context means being significantly different from the majority.

Surely frustration for the majority is inevitable in a society which encourages a success concept which, by definition, is impossible of achievement for all but a small minority.

Yours faithfully,

A. N. DICKSON.

Atomic Energy Establishment,
Winfrith, Dorset.
30 August, 1961.

Engineering Calendar for 1962

A COPY of the ENGINEERING Calendar for 1962 will be presented as a loose inset in next week's issue of ENGINEERING. It will give details of some of the principal engineering exhibitions and conferences due to take place next year.

The calendar is primarily for use as a visible diary, with a writing space for each day of the year. Having the whole of 1962 on one page, it is particularly useful when displayed on an office wall.

Events in Advance

Exhibitions and Conferences

Arranged in chronological order.

Hall Harding Exhibition of Photocopying and Drawing Office Equipment and Materials.—Mon., 25 Sept., to Thurs., 28 Sept., at the Old Assembly Rooms, Westgate Road, Newcastle upon Tyne. Apply to Hall Harding Ltd., Stourton House, Dacre Street, London SW1. Tel. ABBey 7890.

Geophysics Association, International: 12th Colloquium.—Thurs. and Fri., 28 and 29 Sept., at Salzburg. Apply to the secretary, International Geophysics Association, 31 Freisaalgasse, Salzburg, Austria.

Marine Exhibition, International.—Fri., 29 Sept., to Sun., 15 Oct., in Paris. Apply to the Salon Nautique, Port Debilly, Paris 16e.

Industrial, Trade and Domestic Waste Waters, Second International Congress.—Sat., 30 Sept., to Sat., 7 Oct., at Basle. Apply to Pro Aqua A.G., Postfach, Basle 21, Switzerland.

Modern Jewellery, First Major International Exhibition.—In October and November at the Goldsmiths' Hall, Foster Lane, London EC2. The general theme will be the evolution of 20th century jewellery design. Organized in association with the Victoria and Albert Museum. Apply to the Clerk, Worshipful Company of Goldsmiths, Foster Lane, London EC2. Tel. MONarch 1668.

Welding in Shipbuilding, Joint Symposium on.—In October and November, in London. Sponsored by the Royal Institution of Naval Architects, the Institute of Welding, the North East Coast Institution of Engineers and Shipbuilders and the Institution of Engineers and Shipbuilders in Scotland. Apply to the secretary of the organizing committee, c/o the Institute of Welding, 54 Princes Gate, Exhibition Road, South Kensington, London SW7. Tel. KNIghtsbridge 8556.

Electrochemical Society, Autumn Meeting.—Sun., 1 Oct., to Thurs., 5 Oct., in Detroit, Michigan, USA. Organized by the Electrochemical Society, 1860 Broadway, New York 23, USA.

Canadian Convention, Institute of Radio Engineers.—Mon., 2 Oct., to Wed., 4 Oct., at Toronto. Organized by the Institute of Radio Engineers, 1819 Yonge Street, Toronto 7, Canada.

Shoes for Spring Exhibition.—Mon., 2 Oct., to Thurs., 5 Oct., at the Mount Royal Hotel, Marble Arch, London W1. Exhibition includes the display of some shoe and leather machinery. Organized by the British Footwear Manufacturers' Federation, 22 Gilbert Street, London W1. Tel. MAYfair 2843.

Meetings and Papers

The address and telephone number of the headquarters of each institution are given at the end of this list. Meetings in the headquarters town are held there unless otherwise stated.

British Association for Commercial and Industrial Education

LONDON
" Closing the Gap Between Industry and the Schools ": general discussion. London and Home Counties Group. Mullard House, Torrington Place, WC1. Tues., 3 Oct., 2.30 p.m.

British Institution of Radio Engineers

LONDON
" Some Recent Developments in Television Tape Recording," by Dr. P. E. Axon, Dipl. Ing. K. Machein and Aubrey Harris. Television Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 27 Sept., 6 p.m.

CARDIFF
" The SECAM Colour Television System," by G. B. Townsend. South Wales Section. Welsh College of Advanced Technology, Cardiff. Wed., 4 Oct., 6.30 p.m.

FARNBOROUGH
" Lightning: Facts and Fancies," chairman's address, by Dr. W. A. Gambling. Southern Section. Technical College, Farnborough. Tues., 26 Sept., 7 p.m.

WOLVERHAMPTON
" The Single Crystal Circuit," by Dr. D. H. Roberts. West Midlands Section. College of Technology, Wolverhampton. Wed., 27 Sept., 7.15 p.m.

Institute of Marine Engineers and Royal Institution of Naval Architects

SOUTHSEA
" High-Speed Craft," Commander P. Du Cane. Southern Joint Branch. Royal Beach Hotel, Southsea. Tues., 26 Sept., 7.30 p.m.

Institute of Marine Engineers

LOUGHBOROUGH
" Diesel-Electric Installation for Propulsion and Cargo Handling of the Bulk Cement Carrier John Wilson," by H. E. Muckley and J. G. Derrington. West Midlands Section. College of Further Education, Green Close Lane, Loughborough. Thurs., 21 Sept., 6 p.m.

Institute of Petroleum

LONDON
" Airborne Techniques in Petroleum Exploration," by Dr. W. Domzalski. Wed., 20 Sept., 5.30 p.m.

Institution of Locomotive Engineers

LONDON
Presidential Address, by J. F. Harrison. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Tues., 26 Sept., 5.30 p.m.

Institution of Mechanical Engineers

LONDON
Railway Engineering Group: Inaugural Paper. " Some Speculations on the Future of Railway Mechanical Engineering," by Dr. F. T. Barwell. Wed., 4 Oct., 6 p.m.

Institution of Production Engineers and Royal Aeronautical Society

BRISTOL
" Rocket Propulsion of Aerodynamics and Space Vehicles," by E. G. D. Andrews. Large Engineering Lecture Theatre, The University, Queen's Walk, Bristol. Wed., 4 Oct., 7 p.m.

Institution of Production Engineers

NOTTINGHAM
" Application of Spark Machining to Die Making in Different Industries," by J. P. Blackshield. Nottingham Section. Nottingham Reform Club, Victoria Street, Nottingham. Wed., 4 Oct., 7 p.m.

Society of Instrument Technology

LONDON
" Underground Gasification of Coal: Some Features of Instrumentation," by Dr. A. E. Balfour; and " Trends in Mining Instrumentation," by A. E. Bennett. Manson House, 26 Portland Place, W1. Tues., 26 Sept., 7 p.m.

CHESTER
" Our Technology and Our Society," by G. C. Eltenton. Chester Section. Stanley Palace, Watergate Street, Chester. Thurs., 28 Sept., 7 p.m.

GRANGEMOUTH
" Theoretical Aspects of Control Engineering," by J. M. Keating. Grangemouth Section. Leapark Hotel, Bo'ness Road, Grangemouth. Thurs., 21 Sept., 7 p.m.

British Association for Commercial and Industrial Education. Apply to Mr. T. H. J. Field, British Road Services, Melbury House, Melbury Terrace, Marylebone, London NW1. (PADdington 1161)
British Institution of Radio Engineers, 9 Bedford Square, London WC1. (MUSeum 1901)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London EC3. (ROYal 8493)
Institute of Petroleum, 61 New Cavendish Street, London W1. (LANgham 3583)
Institution of Locomotive Engineers, 30 Buckingham Gate, London SW1. (VICtoria 7838)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London SW1. (WHItehall 7476)
Institution of Production Engineers, 10 Chesterfield Street, London W1. (GROsvenor 5254)
Royal Aeronautical Society, Hamilton Place, London W1. (GROsvenor 3515)
Royal Institution of Naval Architects, 10 Upper Belgrave Street, London SW1. (BELgravia 4622)
Society of Instrument Technology, 20 Queen Anne Street, London W1. (LANgham 4251)

Renault's New Utility Car

By Gordon Wilkins

Simplified design, in making a new large car possible at low cost, has been accompanied by features of unusual spaciousness, operating economy and versatility.

The Renault R4L de luxe; the de luxe version adds refinements of detail rather than performance.

IN DESIGNING a replacement for the little rear-engined 4CV which is now at the end of its 14 year production life, Renault have not only switched to a front engine and front wheel drive but they have also abandoned the conventional small car formula. Instead of cutting size to reduce costs, they have produced a relatively big machine with leg and head room which few cars of any size can equal, low cost having been achieved by drastic simplification of design. A similar approach was adopted by Citroen with their 2CV, but it lacks performance and is priced too high for extensive export sales.

Very soft suspension and a high ground clearance of almost 8 in laden enable the new R4 to be used where there are no roads. There are four big side doors and a big lift-up door at the rear giving access to a flat loading platform. Seats consist of light plastic foam pads on rubber bands stretched across tubular frames and can be lifted out in a few seconds. There is space for four adults and 120 lb of luggage, or with the rear seat removed, two adults and 50 cu. ft (400 lb) of freight.

The basis of the structure is a punt of sheet steel, to which the body is attached by 16 bolts. Wings, doors and bonnet are easily removable for repair. All chassis greasing has been eliminated by the use of rubber bushes or bearings with lubricant sealed in. And as a further contribution to economical operation, Renault promise fixed prices for all repair operations.

NEW THREE-SPEED GEARBOX

With the immense capital invested in automatic equipment for production of the 747 cc four-cylinder engine and its 845 cc derivative it was logical to retain this for the new car but it is allied to a new lightweight three-speed gearbox, split vertically along the centre line, and with synchromesh on the top two ratios only. With the original three-speed gearbox, the Dauphine four-speed box and the heavy-duty all-synchromesh direct-drive-top box, in production for the front-drive commercial vehicles and light buses, this makes four different boxes for the same engine.

The engine has wet centrifugally cast liners in an iron block and push-rod-operated valves in a light alloy cylinder head. On a compression ratio of 8·5 to 1 it delivers 26·5 bhp SAE at 4,500 rpm with maximum gross torque of 40·5-lb ft at 2,000 rpm.

The drive shafts to the front wheels have Weiss ball-type universal joints at their inner ends and two needle-roller Hooke-type joints coupled together at their outer ends. Steering is by rack and pinion, with centring springs inside the rack housing.

Front suspension is by long torsion bars extending back to anchorages on a cross member under the front seats. The bar is attached to a lower track control arm in pressed steel, with an adjustable tie rod extending forward at an angle to take braking forces. On the upper side of the arm is the attachment for the telescopic damper, well isolated from casual impacts. The upper member is a pressed steel wishbone. Steering pivots are sealed ball joints and there is an anti-roll bar. The castor angle is 8° and the king pin inclination 13°, thus ensuring freedom from shock and vibration at the steering wheel, but at the cost of rather heavy steering. Rear suspension is by box-section trailing arms attached to transverse torsion bars. As the arms are interchangeable and the bars lie parallel, the car has two different wheelbases: 94·3 in on the left and 96·2 in on the right; but this has no discernible effect on its road behaviour. Torsion bar ends are hexagons; not splines. The telescopic dampers lie horizontally alongside the chassis frame, where they do not reduce the ground clearance.

The radiator is connected to an expansion tank inside the right front wing and the system is filled with a mixture which will resist frost down to temperatures of −33° F. As the temperature rises the expanding coolant displaces air from the expansion tank through an escape valve. On cooling, air re-enters the expansion tank to replace the contracting coolant.

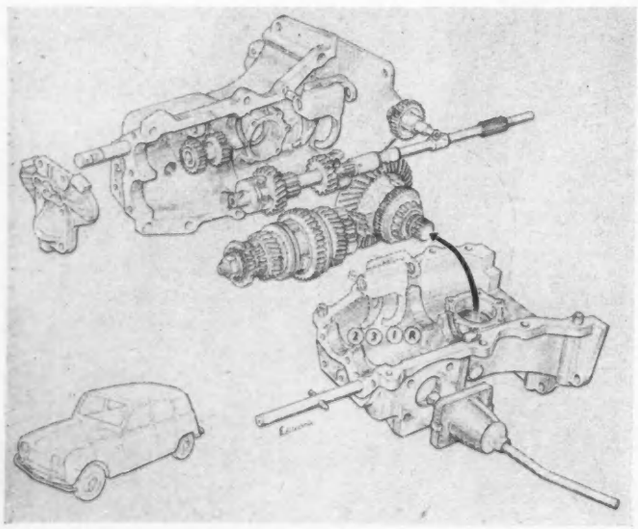
The doors, which are fitted with external hinges, have latches on the insides, which are controlled by bent rods reached through holes in the inner panels. A flap below the windscreen admits fresh air through a gauze screen through two controllable intakes above the instrument panel. Fresh air from the same source also passes down into the heater unit. The front doors have sliding windows, those in the rear doors being fixed. The standard model has no rear quarter windows, no trim panels on the doors, no steering lock or polished grille.

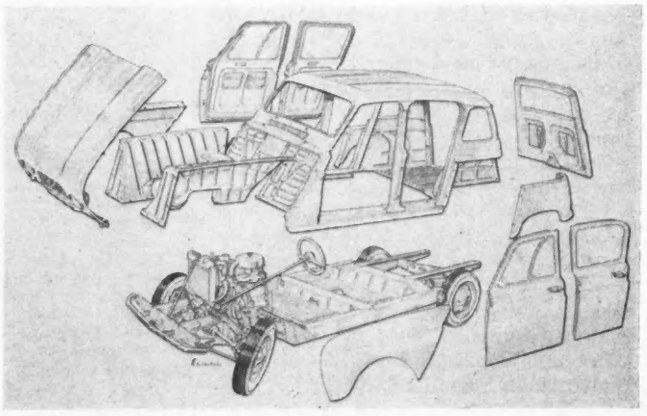
DE LUXE VERSION

The R4L de luxe model has hinged rear quarter windows, combined ignition switch and steering lock. In addition it is equipped with an ashtray, a windscreen washer, and an interior light. Both cars have twin electric horns with town and country switches, twin electric wipers, locks on driver's and rear doors, and heaters; only the R4L heater has a booster fan.

Drum brakes are hydraulically operated, with cable-operated parking brakes on front wheels. The front drums are 7·1 in and the rear 6·3 in diameter, total friction lining area being 54·4 sq. in. A pressure unloading valve helps to prevent the rear wheels locking. Tyres are 145 × 13 and turning circle is a compact 28 ft.

Although it is a much larger car than the 4CV, with its length of 142 in, width of 58 in and height of 60·3 in, the Renault weighs only 1,257 lb at the kerb (1,323 lb in the de luxe form). The 5¾ gallon tank lies under the floor at the back. There is no fuel gauge, but a reserve light is provided and there is a dipstick in the filler neck. The spare wheel is under the floor in a cradle and released by the starting handle.





(Left) The new three-speed gearbox, and (below) structural features of the R4.

Human Element

British Association President for 1961-2

AT THEIR annual meeting in Norwich this year, the British Association for the Advancement of Science have elected Sir John Cockcroft as their President for the year 1961-1962. He will thus preside at the Association's 124th annual meeting when it is held in Manchester in a year's time.

It is a popular and appropriate election. When Sir John was awarded the Atoms for Peace Award earlier this year, the announcement of the award said, "Sir John's contributions to the peaceful uses of the energy within the atom range from the first demonstrations that this energy can be released by man's ingenuity and skill to the direction of the development of full-scale nuclear-powered generating stations supplying electricity. . . . He has taken a leading part . . . in the organization of the Geneva Conferences on the peaceful uses of atomic energy under the sponsorship of the United Nations, in the training of scientists and engineers . . . at Harwell, and in the discussions among scientists and diplomats about the ways in which the potential for benefiting mankind made available through atomic power can best be realized."

Science, Politics and Service

In his presidential address to Section X (General) of this year's annual meeting, the Earl of Cranbrook talked of the divorce between scientific and political thought—a divorce which began with the belief that the scientific method and the preconceived ideas on which practical politics were built could not be compatible. Now this divorce is recognized as an undesirable thing and there is a general view that scientists must influence political development. One way in which the BA and local societies can exercise such an influence is by encouraging wireless listeners and television viewers to enjoy the pleasures of even minor scientific investigations.

In the underdeveloped countries, technical knowledge which has been acquired over many centuries can be handed direct to them. By the same token, the next stage—that of teaching the man in the street to understand the meaning and purpose of science—has taken five or six generations in Western Europe and North America, but can only need two or three at most in these later developing countries. It is necessary that this should be appreciated by the young technicians who go out to the underdeveloped countries from the United Kingdom, and they cannot hope to understand the need for this general education in science if they have not studied the history of those developments in their own country.

Latent Scholastic Ability

When Professor George Seth, of the Queen's University, Belfast, addressed the conference he followed up the point made at the end of the Crowther Report that there is much latent ability which has not declared itself in educational achievement. Too many boys, and proportionately still more girls, leave school early. The girls, in fact, are our largest reservoir of untapped talent and our administrative arrangements must be modified to enable us to make full use of the neglected abilities of women. Here, the problems remain of traditional restrictions upon their employment, and justifiable concern about social return for educational investment. Having regard, however, to the use that industry already makes of its graduate manpower, one might doubt whether we are ready or able to adapt to the kind and degree of innovation rendered possible by an increased flow of educated people.

In the universities the supply of teachers is the main bottleneck. But psychological research into the qualitative aspects of high level mental functioning is necessary, and our traditional or habitual teaching techniques seem ill-designed to stimulate and foster its creative element. Moreover, many of the new undergraduates will be first generation "immigrants" from the grammar schools. Both universities and schools, therefore, have to cope with the problems of inadequate motivation and of dubious attitudes to knowledge and scholarship.

Teacher Training

Mr. L. B. Birch, of the Sheffield University Institute of Education, was another speaker to stress the importance of teacher training, his particular task being to underline the importance of psychology. There are, he said, two contributions that psychology can make to teacher training.

First, it can contribute to the student's own personal growth by helping him to understand his own motives, activities, interests and prejudices and, through the application of what he is taught about other people's learning, he can make himself a better student (a factor, one assumes, that would be true of any educational course). Secondly, that part of psychology which is known as educational psychology is the technology of the teacher's craft. It is like physiology to the doctor or mechanics to the engineer. Without it he must rely on his own intuition and experience which, though invaluable, tend to lead to rule of thumb procedures and provide no frame of reference for evaluating new or old procedures.

At present, Mr. Birch said, the psychology taught in teacher training is broad in its scope but tends to be superficial rather than fundamental. The subject is taught rather as a natural history than a science, descriptions of behaviour being preferred to fundamental principles and causality. A few colleges seem to teach the sort of psychology which was out of date before the war and some to be teaching concepts which have long been shown to be fallacious.

This would seem to point to the need for a serious effort by the universities to train more practising teachers and lecturers in educational psychology and for the training colleges to examine their own methods and syllabuses. In particular they must give their students the ability to and, if possible, the desire, to continue their studies after the end of their course.

Education and the best use of high grade manpower were also tackled in other papers, some of them dealing with such broadly discussed—but less widely understood—subjects as "What the Universities Expect from the Schools," and "Vocational Guidance Interviews." It is important that the British Association should propagate the importance of such subjects, for science will return to its vacuum if it advances beyond the capacity of the educational and political institutions of this essentially, but not exclusively, scientific age.

Mining Accidents Continued Through 1960

From the Report of HM Chief Inspector of Mines and Quarries for 1960, it appears that there was no improvement in the fatal and serious accident rate in coal mining during 1960. Compared with the previous year, the decrease in deaths from 348 to 317 and in serious injuries from 1,676 to 1,573 only reflects the reduction in manshifts between 1959 and 1960.

This has been the position for several years now. The Chief Inspector, Mr. T. A. Rogers comments. "This failure to make any progress in ten years is a matter of serious concern to me, as it must also be to everyone connected with the mining industry . . . at least half of those [accidents] occurring every year could be avoided by compliance with the law or by the exercise of ordinary care."

In fact, the number of surface accidents actually increased (from 22 to 30 killed, and from 174 to 187 seriously injured), a trend which is really worrying because improvements in surface layouts at many collieries should have led to a substantial fall in the accident rate. The number of men killed by falls of ground was the lowest annual figure ever recorded, but these accidents continue with about the same frequency in the more hazardous situations, such as when supports are being disturbed.

Death and serious injury from maluse of explosives were at precisely the 1959 rate, a fact which is very disappointing in view of the reductions in both manpower and output. Most of these accidents were caused by disregard of the law and were the result either of the injured man taking inadequate shelter or of the shotfirer failing to determine the extent of the danger zone.

Ostriches Down the Mines

The Chief Inspector regrets that the amount of water infusion of coal—often, he points out, the most effective dust prevention measure because it wets the coal before it is worked—has declined an favour of other measures which aim it suppressing the dust after it has become airborne. More attention, he states, should be given to deep hole water infusion with the aim of infusing, in one operation, sufficient coal for a week's face advance.

Accidents from mechanical engineering mistakes reached an all time low but this, it appears, has been largely fortuitous, since little real progress has been made in making haulage and transport safer. This, like the installation and maintenance of fire fighting equipment and illumination, is an aspect of safety demanding immediate attention.

While haulage and transport accidents have been kept down in mining—albeit more by luck than judgement—they have increased in quarrying. Now, however, this unfortunate increase might be cut short by a new type of quarrying machine, with specially designed and hardened teeth, which can rip hard sedimentary rocks, as well as soft mineral deposits, in a horizontal plane.

The report draws attention to the fact that first aid arrangements in the smaller quarries are inhibited by an unwillingness among the quarry workers to be trained in first-aid work. This must be the height of ostrich-minded disregard for personal safety. It is a type of mentality which, from this report, appears prevalent in mining and quarrying.

Green Labour for Expanding Factory

Now that the Aircraft Electrical Division of the Plessey Company has begun production in the £½ million Romford factory acquired from Regentone Products last May, it is expected that 700 people will be working there by the end of the year. Within three years the company hopes to bring this figure up to approximately 900.

A training scheme has been set up to meet the immediate problem of expanding the working force, and it is intended to attract people who are not necessarily experienced but are interested in engineering. This is a recognition of the fact that, almost invariably, a properly constituted training scheme must be an integral part of investment in any major extension of production facilities.

The two-storey factory has a total floor area of over 100,000 sq. ft and will supply electrical equipment—including actuators, static and rotary inverters, motors, relays and temperature controllers—for most types of European military and civil aircraft. In addition to production departments, it will have an environmental test laboratory.

Women at Sea

At a time when women are bravely and laudably making inroads into careers and professions, such as engineering, that have always been thought to be man's domain, they are also rolling back a male invasion or usurpation of a role for which the solicitous female would seem to be best suited. The dining rooms of the "Transvaal Castle", now under construction at Clydebank, will be staffed not by horny handed stewards—surely a throwback to salt pork and weevil ridden biscuits—but by sylph-like "stewardettes".

Forty of these sea-going waitresses will be required and recruitment is to begin shortly. They will be paid nearly £40 a month, plus overtime, and after each round voyage of six weeks will have ten days at home to get back their land legs (not that their sea legs . . .).

Their uniforms have been designed by Mr. Hardy Amies which, apparently, is a good thing. To fill in the detail for the prospective male passenger who is already dreaming pleasurably of weeks afloat in such company, this uniform will be "a straight [stewardettes permitting, presumably] dress in pale mauve terylene worsted material, with kimona style three-quarter length sleeves . . . long waisted with a tucked seam at the hips and . . . a high round neck tied in a bow at the front."

Woman's victory is not yet complete, however. There will be a male head waiter. This post is filled.

Mechanization of the Postal Services

Roughly 40 per cent of the cost of mail is attributable to sorting office costs. It is here that mechanization is most needed. New coding and automatic letter sorting techniques show great promise.

By Brigadier K. S. Holmes, C.B.E.

Director of Postal Services in the British Post Office

ALTHOUGH the postal service is the oldest of our communication services, it has proved much more resistant to mechanization than the others. Even today it is operated very largely on the basis of manual effort: roughly 70 per cent of its costs are staff costs, a large part of the remainder being charges for conveyance of the mails.

At first sight, postal operations appear to be an easy subject for mechanization. Many of them are highly repetitive in character. They also occur in immense numbers.

What is it then which has proved to be so baffling about mechanization of the service; what developments are now taking place; and what are the prospects for the future? I will try to answer these questions by referring in the main to the British postal service, which is probably fairly typical, and which has lately seen advances in the field of mechanization which it might be claimed are unsurpassed abroad.

Postal Costs

Leaving aside payments for conveyance, the costs of handling letters and parcels break down roughly as follows: (i) collection, 10 per cent; (ii) delivery, 40 per cent; (iii) sorting office costs, 40 per cent; (iv) miscellaneous, 10 per cent.

Except for the fact that they can be motorized, collection and delivery offer virtually no scope for mechanization. Neither does the work which falls under the heading "miscellaneous." Only in sorting offices is there scope for mechanization and there the dividends could be high.

Sorting Office Mechanization

Belt and chain conveyors, some of sophisticated design, are being used in growing numbers to move mail between work points. We shall soon see them carrying mail direct between sorting offices and railway station platforms. But the sorting processes themselves have long remained unsubdued, all efforts to mechanize them having been defeated until recently. The most pressing need is for a mechanized letter sorting system, and the development of such a system forms the main subject of this paper.

Paper presented to the Engineering Section of the British Association, meeting in Norwich, September, 1961.

Postal Service Organization

To understand what is involved in mechanizing the sorting of letters and parcels a knowledge of the following facts is desirable:

(1) On its way to its destination a letter passes through numerous hands and processes. Collections made from posting boxes and post offices are taken into a sorting office—the office of posting—where the letters are sorted into destinations and then sent on by rail, road, or air.

(2) For postal delivery purposes the country is divided into 1,700 areas; each contains an office of service through which all incoming correspondence for delivery in the area must pass. These 1,700 offices are known as "post towns."

(3) Superimposed upon this system of "post town" areas, there are some 40 distributing offices, each acting as a mail distributing centre for the post towns in a specified area—which may comprise one or more counties. There are also some 13 large post offices and a considerable number of mobile offices (railway travelling post offices) which act as general forwarding offices for mail.

(4) A letter may be routed from the office of posting to its destination either direct or via an intermediate distributing or forwarding office (where it may be re-sorted) according to the amount of traffic available at the particular time of day.

(5) On arrival at the office of delivery letters are sorted into geographical groups of streets—the postmen's delivery rounds. The delivering postman finally sorts the items into order of street and house delivery before setting out on his round.

The treatment of parcels is much on the same lines as letters.

Mechanization of Parcel Sorting

This is essentially a problem of handling bulky articles, which in the British service may run up to 22 lb in weight. Early attempts to mechanize consisted of sorting parcels, by hand, on to a number of conveyor belts—primary sorting. The conveyors carried the parcels away to points where they were given a further subdivision—secondary sorting—again by hand. The number of primary divisions into which parcels could be sorted mechanically in this way was limited to about a dozen.

Parcel sorting machines built in recent years have provided for mechanical subdivision into as many as 40 or more selections. They are mostly push-button controlled and constructed on a common principle—a parcel, of which the address has been read by an operator (the sorter) is placed, either by hand or mechanically, on a primary conveyor which in turn traverses a number of secondary conveyors each leading to a different dispatch point. A built-in memory and release system, which is set by the operator as he reads the address on the parcel, provides for the parcel to be transferred from the primary to the appropriate secondary conveyor at a particular point along the primary conveyor's track.

The primary conveyor may be either:

(1) an endless chain to which "buckets," to hold the parcels, are attached (with the Sovex type of parcel sorting machine at Leeds each "bucket" has a false bottom which opens to let the parcel fall on to the appropriate secondary conveyor);

(2) an endless chain, moving in a horizontal plane, to which "trays" are attached to hold the parcels. (A machine of this type—TOPSI—is being built for use at Bristol. Transfer from primary to secondary conveyor is achieved by letting the parcel slide out of the tray, which is inclined);

(3) a plain conveyor band on whose surface parcels are carried to the points of transfer to the secondary conveyors. (Transfer can be obtained either by power driven ram, or by a blast of compressed air, or, most simply, by gravity by tilting the primary conveyor band—as in a machine being built for Worcester.)

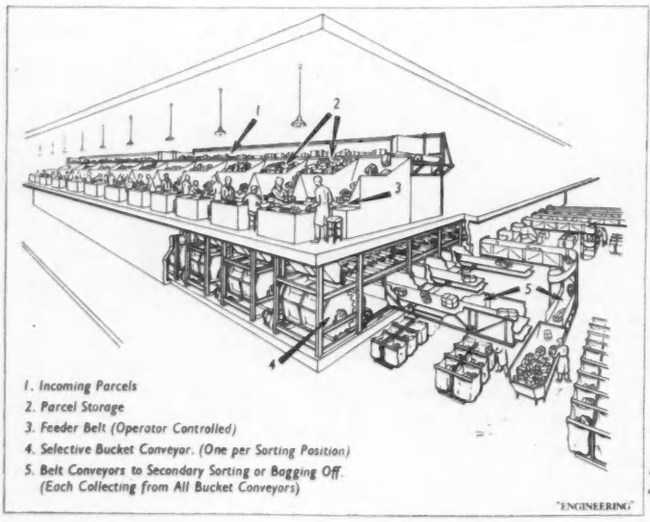
Of the mechanized parcel sorting installations built in this country to date the most sophisticated is at Leeds. This installation can handle 10,000 parcels an hour, see Fig. 1. Movement through the office is almost wholly mechanized.

Mechanical Sorting of Letters

This is the biggest single sorting problem which the Post Office has on its hands. Two things combine to make economic mechanization difficult:—

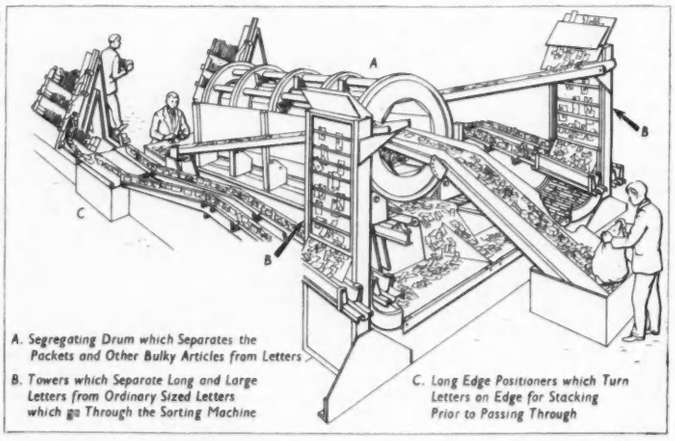
(1) the non-standard character of the article to be handled—letters vary in size, shape, weight, stiffness, colour, markings, make-up, and in the way in which they are addressed;

(2) the uneven flow of work—more than half the letters posted reach sorting offices after 5 pm



1. Incoming Parcels
2. Parcel Storage
3. Feeder Belt (Operator Controlled)
4. Selective Bucket Conveyor. (One per Sorting Position)
5. Belt Conveyors to Secondary Sorting or Bagging Off. (Each Collecting from All Bucket Conveyors)

Fig. 1 (left) Pictorial drawing of the Sovex parcel sorting installation at Leeds.



A. Segregating Drum which Separates the Packets and Other Bulky Articles from Letters

B. Towers which Separate Long and Large Letters from Ordinary Sized Letters which go Through the Sorting Machine

C. Long Edge Positioners which Turn Letters on Edge for Stacking Prior to Passing Through

Fig. 2 (above) Letter and packet segregating machine, with letter separating and stacking devices.

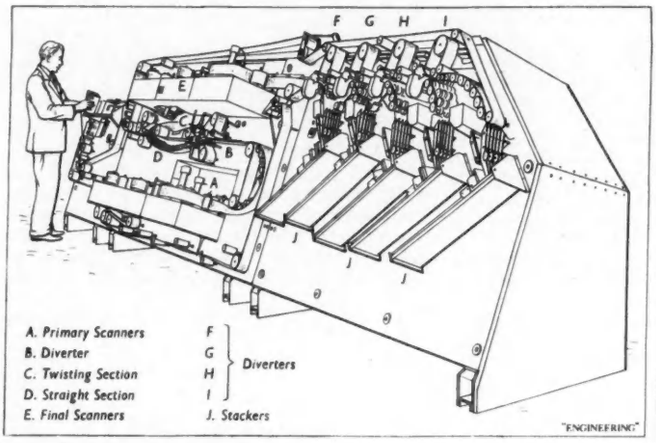


Fig. 3 (above) Letter facing machine showing principles of operation.

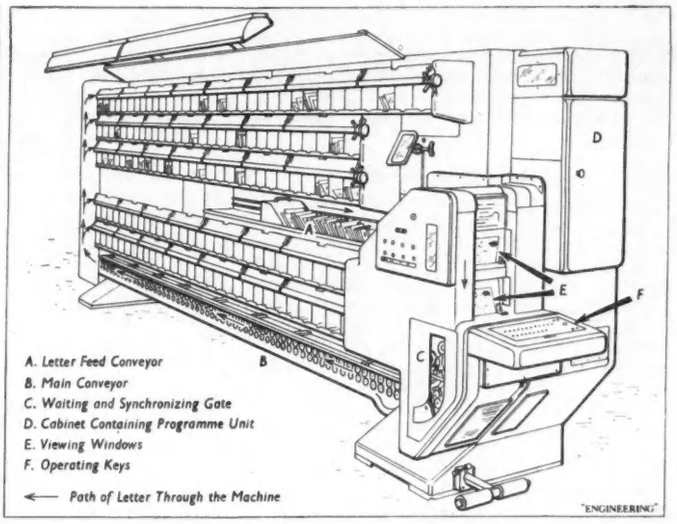


Fig. 4 (right) Single position letter sorting machine.

and over 80 per cent of the mail is delivered before 9 am next morning.

The processing of letters in sorting offices falls into two parts: (1) preparation for sorting; and (2) sorting itself.

Preparing Letters for Sorting

Correspondence brought into sorting offices from pillar boxes and post offices comprises letters, postcards, small packets, rolled magazines, newspapers, and so on. These items cannot be handled together conveniently; so that before sorting can begin we have to:—

(1) separate the letters from the packets;
(2) separate large letters from small ones; and then
(3) " face " the letters, that is, arrange them all with the addresses the same way up and with the stamps in the same corner ready for passing through the stamping machine: at the same time the printed papers paid at 2*d* must be picked out (these are sorted and despatched after the fully paid—3*d* etc.—letters have been dealt with); and
(4) cancel the stamps.

Until recently the first three of these jobs had everywhere been done by hand. Machines which can do them automatically have now been developed and given successful field trials. They include:—

(1) **A segregating machine.**—This is a revolving drum, tilted downwards, whose sides are a series of hinged flaps, see Fig. 2. The mixed mail is fed into the drum at the higher end. As it works its way down the letters slip out through the gaps between the flaps on to a conveyor belt which carries them to separating and stacking devices. Packets work their way down the drum and emerge at the lower end;
(2) **Separating and stacking devices.**—These separate large letters from smaller ones. Separation is achieved partly by passing the stream of letters up a vertical frame of powered rollers. Large letters bridge the gaps between the rollers and travel to the top of the tower: the others cannot do so and fall out onto separate conveyors. Further refinement is achieved by passing the letter stream beneath " snatch rollers " which pluck out any large letters which may have remained with the small ones. The letters finally reach mechanical stacking devices which put them in neat piles graded according to size;
(3) **The facing machine.**—This takes letters as they come in random orientation from the stacking devices, re-arranges them so that all the addresses are the same way up, picks out the 2*d* letters, cancels the stamps on all the letters and puts them into neat stacks ready for sorting, see Fig. 3.

The mechanical facing of letters presents numerous problems—not least that of locating the position of the stamp on the envelope and, when this has been done, rearranging the envelopes so that all the addresses face the same way and the stamps are in the same corner of the stack. There is also the problem of distinguishing between 2*d* stamps and those of other values. To resolve these problems research was first concentrated on optical scanning of the envelope. Unfortunately the presence of other markings—e.g. Christmas seals—and the difficulty of distinguishing between the colour of the 2*d* stamp and the rest made this method unreliable. The scanners were confused. Accuracy never exceeded 90 per cent, even in a laboratory.

It was therefore decided to incorporate in the stamp itself a characteristic which, while not defacing the stamp, could be identified with reasonable certainty. In the first experiments graphite lines were printed on the reverse side of stamps under the gum—one line on the 2*d* stamp and two on other denominations. Recognition was achieved by passing a high voltage current (1,000 volts) between " feelers " which swept the stamps as the envelopes passed beneath. Completion of a discharge circuit through the paper and along a graphite line signalled the presence of a stamp. This system gave much better results than optical scanning but was not free from difficulty—printing costs were considerable and the graphite lines tended to fracture when the stamp was moistened and applied to the envelope.

A further improvement has come with the development of a new and harmless organic phosphor which is line-printed on the face of the stamps during manufacture. It is cheap to produce and virtually invisible in ordinary light. When exposed to ultra-violet light in the frequency range of 2,500-2,600 Angstroms it glows strongly and recognition by the scanners is positive and certain. Accuracy of stamp recognition is virtually 100 per cent.

Once the stamps have been located there remains the problem of rearranging the envelopes so that all addresses are the same way up. This is achieved by passing them in a spaced stream between double conveyor bands: envelopes with their addresses facing the " wrong " way are diverted and turned around in a twisted belt so that when they rejoin the main stream they are the right way up.

Sorting Letters

Since there are 1,700 separate post towns to which letters can be addressed, and since even the ordinary sized town may easily have a hundred or so postmen's delivery rounds, it is easy to see that a letter will be sorted several times before it reaches the postman who delivers it.

Practically all sorting is done by hand to a frame of boxes, each about 6 in by 5 in in section. The process is limited in two ways: (i) in speed—a man takes time to pick up a letter, read the address, and put it in a box; and (ii) in the number of boxes (48) which a man can conveniently reach.

Sorting machines built to date have been designed to overcome these limitations. Using the British single-position letter-sorting machine for instance, see Fig. 4, an operator can sort letters to 144 boxes at about 3,000 an hour—twice the speed of a manual sorter. The machine works like this:—

(1) an operator sits at one end with a keyboard (12 by 12 keys) in front of him;
(2) the machine takes letters one at a time from a stack and shows them to the operator through a viewing window;
(3) the operator reads the address and, on the basis of a memorized code, presses two of his keys, thereby indicating to the machine into which of 144 pigeon-holes the letter must be put;
(4) the letter is immediately carried away-through powered roller tracks, to the appro, priate pigeon-hole and, at the same time, the next letter is presented to the operator.

The machine is arythmic in operation: the operator can make his own pace, just as he does when sorting manually, pausing to read badly-written addresses, and speeding up with ones written clearly. This is one respect in which the British machine differs from others which have been developed abroad, notably the Transorma (Dutch) and Bell (Belgian) machines. These are multiple position machines operating to a fixed rhythm: an operator must either take advantage of a " sorting opportunity " or let it go. He cannot in any case speed up or " beat " the rhythm of the machine. This can be a disadvantage; letters tend to appear in " runs," something like a quarter of all those posted being for local delivery and many of the remainder being for large cities and nearby towns.

All letter sorting machines in current use are operator controlled, and have two limitations in that they are tied: (i) to the operator's speed—the machine could go faster if the operator could; and (ii) to his memory—he must remember the keying code for each division into which he sorts.

A perfect sorting machine would read the address on any envelope and sort it automatically. It is problematical whether such a machine will ever appear—at least at a price at which it could be used economically! It is true that laboratory " rigs " have been built to recognize a limited range of place names typed in specialized characters on envelopes and to sort the envelopes into a few divisions. But it is a far cry from this sort of thing to the " reading " (and sorting) of place names typed in any sort of character, and farther still to the " reading " of handwriting.

But despite the uncertainty, it would be wrong to dismiss the idea of a robot sorter—it must clearly be the ultimate goal, and research and development must be directed towards it. The problem to which postal administrations have

had to address themselves of late is whether any progress could be made in the foreseeable future beyond the operator-controlled style of sorting machine towards fully automatic sorting. This question has been answered affirmatively with the emergence of a new technique known as "coding."

Coding and Automatic Sorting

The average letter is sorted three times before it reaches the delivery postman. Many letters are sorted five or six times. If, when a letter was first sorted, the ordinary written address could be converted into machine language and stamped in this form on the envelope—it should be possible to sort the letter at the second and subsequent stages automatically. An automatic machine could itself read the machine language and thus be free to sort faster and to as many selections as required. With this method the saving of manual effort at the second and subsequent stages would be much greater than could ever be attained with operator-controlled machines. At the first stage moreover the work of reading the address and marking the envelope could be divorced from the sorting process and the work of several operators fed to one automatic sorting machine. This would open the way to a reduction of machine costs. In short, coding/sorting—as it has been called—would be a notable advance over operator-controlled machine sorting. It was decided, some three years ago, to press on with it.

Development of the new technique called for solution of many problems. Foremost was that of converting the ordinary address to a form which could be read automatically. I shall call this conversion process "coding." In relation to the "post-town" section of the address coding involves: (i) reading the name of the post-town; and (ii) operating a machine which will convert this name to machine language and impress it in that form on the envelope.

The names of the 1,700 post-towns in the United Kingdom vary in length from 3 letters (for example, Ayr) to 14 or more (Berwick-on-Tweed). Time would not allow the operator of a coding machine to type out the longer names in full. They must be condensed to the shortest form consistent with preservation of their individuality. This requires extraction of certain key letters and their typing out on a machine—extraction coding as the process is known.

After much study it was decided that the code extraction pattern which gave the optimum results was one which relied upon extraction of the first three and last two letters of the name of the post-town, thus:

MANCHESTER	= MANER
NORWICH	= NORCH
LEEDS	= LEEDS
AYR	= AYRYR

The next problem was to build machines which would: (i) convert the extraction pattern into machine language—binary code—and stamp this on the envelope; and (ii) read the marked letters and sort them automatically.

Process (i) requires two pieces of equipment—a coding desk and a code-translator. The former comprises a keyboard resembling that of a typewriter on which the coding operator types the letters extracted from the post-town name, for example, "MANER" from "Manchester". The action of keying sets up signals which are translated into a pattern of binary dots by a code translator. The dots appear on the envelope as a pattern of phosphorescent spots alongside the ordinary address, see Fig. 5. To ensure adhesion of the phosphor to the envelope it is applied from a phosphor-wax tape by the pressure of hot needles. The phosphor—a different one from the stamp phosphor—is practically invisible in ordinary light but glows brightly after radiation by ultraviolet light in the range of 3,000-3,600 Angstroms.

Letters bearing the phosphorescent spot patterns pass from the coding desks to an automatic sorting machine in which the operator is replaced by a reading head. Translation of the spot patterns is achieved by reference to the code-translator; this signals back, for any particular spot pattern, "instructions" which tell the letter conveying system of the sorting machine to which one of its boxes it should guide the particular letter.

Translation of any code combination is effected in 25 milliseconds. The translator can thus be shared by a considerable number of coding desks and automatic sorting machines.

Prototype coding desks and automatic sorting machines were brought into operation in the sorting office at Luton on 21 June, 1960, the first time letters had anywhere been coded and sorted automatically. The results obtained have shown steady improvement, the proportion of incorrect sortings for the whole process—including coding—having fallen until it is now less than 10 per 1,000. Although this figure will be further reduced it can be taken as a clear indication that coding/sorting is a practicable proposition.

Weakness of Extraction Coding

Reference has so far been made only to the encoding of the name of the post-town and to the fact that to keep ambiguities within manageable proportions not less than five characters must be extracted. But, to take full advantage of coding and automatic sorting we also want to encode the name of the street to which a letter is addressed and to do this another five characters must be extracted. This means typing out ten characters from every address. There is not sufficient time to do this at many offices of posting. Two separate coding operations would be required—one at the office of posting to extract the post-town code, and one at the office of delivery to extract the street code.

Postal Codes for Public Use

These two extractions could be reduced to one, and problems caused by ambiguities resolved, if people were prepared to help by using a postal code as part of their normal postal address. A code of six characters can provide for every postal address in the country. A postal address with its postal code added would look like this:

Mrs. K. Jones,
26 North Street,
NORWICH, Norfolk,
NOR 36L.

where "NOR" represents "Norwich" and "36L" represents "North Street."

If codes of this type were in general use, the encoding operation could be greatly simplified. All the coding operator would have to do would be to read the postal code, for example, "NOR 36L," and type it out on his keyboard. Two rows of phosphorescent spots would appear on the envelope—one representing the post town and the other the street of delivery, see Fig. 6. Once a letter was marked in this way, it could be sorted automatically at all stages up to the point where it is given to a postman to deliver.

The question is whether people are prepared to use codes in this way, and whether they will use them accurately. The answer is being sought in Norwich. Every street, road, avenue, and many firms in the Norwich postal area have been allotted a separate postal code of six characters as in the example quoted. People have been asked to show their code as a part of the normal postal address at the head of their notepaper, so that their correspondents will use it when writing to them. A good proportion of the mail being received in the city for delivery now carries a postal code.

There are ten letter sorting machines of the latest operator-controlled type in use in the Norwich sorting office. These have recently been modified, by addition of typewriter-type keyboards and code translators, so that practical use can be made of the postal codes appearing on letters addressed to Norwich. The operators using the machines need no longer memorize the keying combinations for streets and roads in the area—they work either by copying the postal codes appearing on the letters or, if there is no code shown, by extracting a set pattern of five letters from the street name and typing that out. The machines do the rest, putting the letters into boxes corresponding to the 1,800 or so different streets, roads, avenues, etc. in the Norwich area.

The experiments which are being made at Luton and Norwich are complementary. If successful they could bring about a major change in the methods now used for sorting letters.

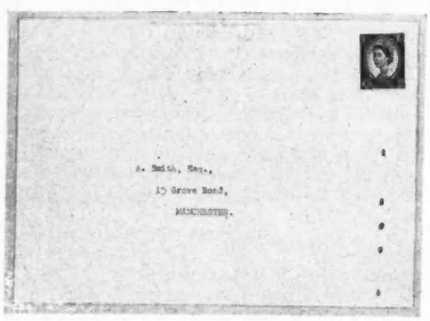


Fig. 5 Envelope showing typical address and phosphorescent spot pattern corresponding to the post-town, in this case "MANER"—MANchestER.

Fig. 6 Envelope bearing a typical address and postal code, with corresponding phosphorescent spot patterns. The left-hand spot pattern represents "36L" and the right-hand pattern "NOR"—Norwich.

Conclusion

The emergence of the new coding technique has opened up new and promising prospects in the application of mechanical sorting. The next phase must be to perfect and cheapen the new equipment so that what now promises to be a technical success shall also be commercially successful. Much original research and development by the Post Office Engineering Department has gone into the evolution of the new techniques. It would be surprising if some of them, such as the phosphorescent spot technique, did not have applications outside the Post Office.

But in the postal field itself it remains to be seen whether public cooperation in the use of postal codes can be secured. If it can, it might even pave the way for still further progress towards the ultimate goal, a robot sorter. An automatic sorting machine reading postal codes put on by the public is surely a much less visionary idea than a machine reading ordinary addresses. In the firm belief that this may well prove to be the case research has lately been started by the Post Office into the automatic reading of postal codes put on envelopes by the public at large.

Meanwhile, the Post Office is pressing ahead with the application to its work of the more conventional forms of mechanization. Its policy is to introduce a machine wherever it can do the work more efficiently and cheaply than by manual effort. Its aim is to maintain and wherever possible improve the quality of the postal service while at the same time holding down costs.

Preserved Timber for Construction Work

Among the hazards which face structural timbers are attack by fungi and insects. Tar oil, water-borne and organic solvent preservatives are now all widely used making hitherto unconsidered species suitable for construction. Resistance to fire is also increased by suitable fire retardants.

By Wm. E. Bruce, M.A., F.I.W.Sc.

Secretary, British Wood Preserving Association

THE forest regions of the world contain thousands of tree species which differ not only in form of leaf and fruit and in habit of growth but also in the timber which comprises the wood tissues. Timber is not a single material but a large group of materials varying in physical and mechanical properties. The use of timber as a material of construction is of great antiquity: since the Stone Age many different woods have been employed by man and it is therefore not surprising that, in certain parts of the world, forest areas are diminishing or that some species are becoming increasingly difficult to obtain.

The properties most generally sought in a timber are ease of working, mechanical properties suited to the purpose for which it is to be used, and weight per cu. ft as low as possible compatible with the strength required. The constructor may also be concerned with other problems such as stability of dimensions and freedom from warping. It often happens that these qualities occur together in timbers which are not naturally resistant to decay, and are liable to infestation by insects and injurious animal organisms. In consequence, such tembers require to be efficiently treated with a preservative if they are to be used economically, with a minimum of expenditure on repairs or replacements, where local conditions are favourable to fungi, destructive insects or animal organisms.

In Great Britain there has been tremendous expansion in the timber preservation industry during the post-war years. The increased importance of timber preservation as an ancillary industry to the timber trade and to the timber using industries has been due to a number of reasons. Timber is no longer a cheap material and has been subjected to intense competition from other materials such as steel, concrete and aluminium, so that the user now demands the maximum possible life from timber with the minimum expenditure on maintenance.

With the shortages of timber during the war and post-war years timber was used very much more scientifically than in the past. This helped it to compete more successfully with other materials and opened up new markets, but it also meant that, if used untreated under conditions where there was a danger of insect or fungal attack, there was no longer the safety margin which had existed in the past when normally far larger timber sizes had been used than were required. In addition, whereas in the past much of the softwood for constructional purposes had come from the natural forests where the trees had taken from 200 to 600 years to grow and in which there was a small proportion of sapwood, in the post-war period most of the softwood has come from plantations where the aim has been to produce a marketable tree in 90 to 120 years or less. This timber has a very much higher percentage of sapwood which is usually more susceptible to fungal and insect attack than the heartwood.

Since the war there has also been a far wider study of timber technology and in particular an increase of research work on timber preservatives and their application. Before the war much of the timber preservation carried out in Great Britain was with creosote and related to railway sleepers and transmission poles with a certain volume of timber for marine and agricultural uses. Today in Great Britain there are more pressure impregnation plants carrying out treatment with the water-borne preservatives than those using creosote. There has also been a great increase in the use of the organic solvent type preservatives, not only for the *in situ* curative treatment of timber, but also for certain pre-treatment purposes.

* Paper presented to the Engineering Section of the British Association at Norwich, Sept, 1961.

TIMBER DURABILITY

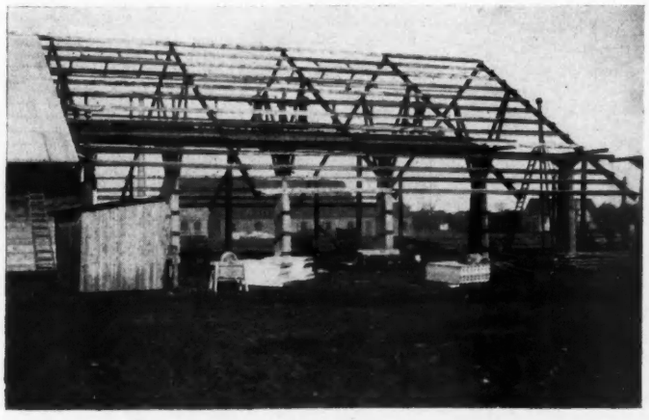
The timber of most species contains heartwood and sapwood, but when reference is made to the durability of timber, such reference is to the heartwood, for the sapwood of almost all timbers is either perishable or non-durable and is generally more susceptible to insect attack than is heartwood. Woods vary greatly in their durability when used under conditions conductive to decay. Some woods such as ash or beech may be rapidly destroyed, whereas the heartwoods of others, such as oak, teak or greenheart, have a high natural resistance to fungal decay and will remain serviceable for many years. Some resistant species, however, are relatively expensive either through inadequate supply, difficulty of working or other factors and it is frequently advisable and more economical to use treated timbers which are naturally non-durable rather than naturally durable ones. It is not possible in such a paper as this to give precise recommendations on the natural durability of timber. Much useful information will be found in *Forest Products Research Records, No. 30*; *Wood Preservation Series No. 4, The Natural Durability of Timber*; *A Handbook of Hardwoods* and *A Handbook of Softwoods*, all published by HMSO.

WOOD DESTROYING AGENCIES

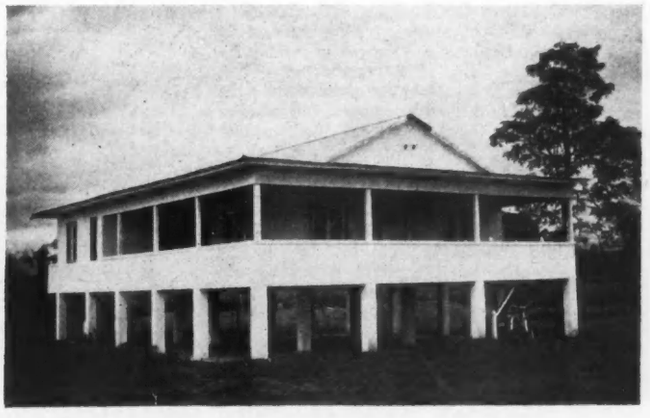
For engineers and architects it is necessary to consider two differing sets of hazards to which timber may be exposed in use. The first set of hazards affects timber for buildings, the second affects timber used for such purposes as marine piling, fendering, groynes, and river defence works.

Wood-destroying fungi which cause decay do not attack timber unless its moisture content is above about 20 per cent. Generally speaking, if a building is properly designed and constructed in accordance with well-known principles, and provided also that it is reasonably well maintained, the timber can be kept below the moisture content at which there is a danger of attack. Unfortunately, in so many cases, maintenance falls short of what is desirable. The prinipal fungi likely to attack timber in buildings are *Merulius lacrymans* (dry rot), which normally attacks softwoods but having established itself in a softwood may spread to hardwoods, *Coniophora cerebella* (wet rot or cellar fungus) which attacks softwoods and hardwoods and certain *Poria* species attacking softwoods.

Although it is possible to detail certain conditions under which fungal attack may occur, it is more difficult to set out the conditions under which insect attack will take place. It can, however, be said that millions of pounds are spent annually on the curative and remedial treatment of timber *in situ* suffering from fungal and insect infestation. The wood-boring insects which may attack timber in buildings are *Anobium punctatum* (common furniture beetle) which attacks the sapwood of hardwoods and softwoods and sometimes bores into the heartwood; *Xestobium rufovillosum* (death watch beetle) which normally attacks hardwoods, though softwoods are not immune from attack (both sapwood and heartwood may be attacked); *Lyctus* spp which attack the sapwood of partially seasoned or recently dried hardwood timbers, where the pores will admit the ovipositors of the female for egg laying; and *Hylotrupes bajulus* (house longhorn beetle) which attacks the sapwood of softwoods. In Great Britain, attack by the death watch beetle occurs normally in the area of England south of a line drawn roughly from Ormskirk in Lancashire to Hull in York-



Treated timber for a modern storehouse.



A bungalow in South America built with treated timber.

shire. Attack by the house longhorn beetle is fortunately at present largely restricted to certain localities principally in south-east England.

Timbers for marine work, if used in salt or brackish water, are also liable to attack by marine borers such as ship worm (*Terredo* spp) and gribble (*Limnoria* spp). No timbers are regarded as completely immune from attack by shipworm and gribble, though the heartwood of certain species has been found to offer satisfactory resistance to attack—e.g. jarrah, turpentine, ekki, okan, Basra locus and greenheart. There is also a danger that timbers used in water may be attacked by " soft rot," a term covering various species of *Ascomycetes* or *Fungi imperfecti*. The area most susceptible to attack is between high and low water levels. A beetle which also does a certain amount of damage to piles and dock timbers is the wharf borer, *Nacerdes melanura*. It usually colonises in wet or sodden woodwork. It will not occur where there is efficient building maintenance and the timber is free from fungal decay.

WHEN SHOULD TIMBER BE PRESERVED ?

In a booklet on timber preservation issued jointly by the British Wood Preserving Association and the Timber Development Association, reference is made in the foreword to the fact that preservative treatment of timber should be employed under certain conditions of use or service of which the following were considered typical examples:—

(*a*) in contact with the ground;
(*b*) at or below damp-proof course level in buildings and structures;
(*c*) wholly enclosed in brickwork, concrete or masonry;
(*d*) in any situation in which adequate ventilation cannot be provided;
(*e*) in any situation in which the equilibrium moisture content of the timber is likely to exceed 20 per cent;
(*f*) timber classified as of low durability, or with a fair amount of sapwood, and used in circumstances in which there is reasonable doubt of service conditions in regard to temperature, ventilation and humidity;
(*g*) in special cases in areas where fungal or insect attack is known to be prevalent; and
(*h*) where subject to attack by marine or other water-borne organisms.

The principles given above provide a useful guide on the subject of the proper treatment of timber. It should further be remembered that should either fungal, insect or marine borer attack occur in any structures large sums of money will have to be spent on remedial and replacement work. It is not merely a matter of treating certain timbers *in situ* nor of purchasing replacement timbers, for often heavy labour charges are incurred in carrying out the work.

The precise conditions under which timber is to be used should be carefully studied and should then be related to the advisability of using pretreated timber at the time of erecting a structure. Timber is pre-eminent as a constructional material and timber which is efficiently treated can be used with confidence. The small additional cost of treatment should be regarded as an insurance premium paid once to ensure immunity from fungal and insect attack during the lifetime of a building.

Today sawn timber and plywood are facing increasing competition from other materials. The use of these other materials has to some extent been due to changes in forms of construction but on occasion because of the assumed superiority of other materials under certain conditions of use. Such competition may intensify as new materials are developed, existing ones improved or cheapened by mass production, automation, better components and cheaper processes. It is therefore not sufficient to point out the many virtues of wood. It is wiser in the long run to face up to the inherent defects in natural wood and prove to the consumer, engineer and architect that these can be corrected. Proper and efficient timber preservation can do a great deal to maintain existing markets and even develop new ones for timber and can at the same time help to restore confidence in timber as a material of construction. Although preservative treatment will increase the initial price of the timber, it is still justifiable and even economical to the user if it gives longer trouble free service life with reduced maintenance charges.

Piling and decking of treated timber.

WOOD PRESERVATIVES IN COMMON USE

The effectiveness of any substance for the preservation of wood depends on a number of factors of which the most important are:

(*a*) toxicity towards wood destroying fungi, timber-boring insects and other destructive organisms;
(*b*) permanence, i.e. resistance to leaching, evaporation and chemical decomposition;
(*c*) penetrating power, e.g. low viscosity at temperatures at which the product is normally applied; and
(*d*) freedom from undesirable effects on timber, metals and operatives.

The materials given below are the most commonly used preservative substances in Great Britain and most of the proprietary preservatives are based on one or more of them, with or without additional substances for other purposes, such as water-repellents, insecticidal materials and anti-bloom agents.

Class TO—Tar Oil Preservatives

(i) Coal tar creosote to BS 144, " Coal Tar Creosote for the Preservation of Timber."
(ii) Coal tar oil types other than creosote complying with BS 3051, " Coal Tar Oil Types of Wood Preservatives other than Creosote to BS 144."

Creosote is normally applied by pressure impregnation, which should be carried out in accordance with BS 913, " Pressure Creosoting of Timber," though the hot and cold open tank treatment is used on a number of estates and farms and some creosoting is carried out by dipping and brushing. There are about 50 commercial pressure creosoting plants in Great Britain plus a number of small estate plants. Coal tar oil types other than creosote are normally applied by non-pressure methods such as steeping, dipping, brushing or spraying.

Class WB—Water-Borne Preservatives

(i) Copper/chrome, BWPA Standard 100.
(ii) Copper/chrome/arsenic, BWPA Standards 102 and 103.
(iii) Fluor/chrome/arsenate/dinitrophenol, BWPA Standard 101.
(iv) Others—e.g. borates, copper sulphate, mercuric chloride, sodium fluoride, sodium ortho phenylphenate, sodium pentachlorophenate, zinc chloride and organic mercurial derivatives.

Types WB (i), (ii) and (iii) are normally applied by pressure impregnation and (i) and (ii) are the water-borne preservatives generally used for the pre-treatment of timber in Great Britain. Type (iii), while still used to a small extent, has been largely replaced by type (ii) in recent years. There are over 80 commercial pressure impregnation plants operating with these preservatives in Great Britain. A number of estates also use these preservatives with smaller pressure plants. There is also one commercial pressure plant operating with zinc chloride/sulphate of alumina. Types WB (iv) are only used to a minor extent or for specialist purposes. These modern water-borne formulations applied by vacuum pressure impregnation are well fixed in the wood and aim at the twin objectives of initial toxic efficacy and long term permanence of that toxicity. Treated timber after drying is clean to handle and can then be painted or varnished.

Class OS—Organic Solvent Preservatives

(i) Chlorinated naphthalenes and other chlorinated hydrocarbons.
(ii) Copper naphthenate and zinc naphthenate.
(iii) Pentachlorophenol and its derivatives.
(iv) Mixtures of the types named above, e.g. copper pentachlorophenate.

The organic solvent type preservatives are normally applied by steeping, dipping, brushing and spraying. In the United States and other overseas countries, where petroleum solvents are relatively inexpensive, solvent preservatives are applied more generally by pressure impregnation but in the United Kingdom the solvents used are relatively expensive. Pressure impregnation, therefore, is employed mainly where the particular advantages from the properties of this class of preservative outweigh the question of cost.

The organic solvent type preservatives with suitable solvents permit deep penetration of dry and seasoned timber and allow the treated timber to be painted. Treated timber is clean to handle and requires little no no re-drying after treatment.

In selecting a wood preservative there are a number of considerations to bear in mind, although in practice certain overriding factors such as cost, colour, smell, subsequent painting and swelling effects may necessitate a compromise over other desiderata. Much useful information on this subject and on the characteristics of the various types of preservative will be found in the blue booklet *Timber Preservation* published jointly by the British Wood Preserving Association and the Timber Development Association, in BWPA Leaflets 8—*Creosote*, 9—*Wood Preservatives of the Organic Solvent Type*, 10—*The Use of Water-Borne Preservatives for Timber*, and in Code of Practice CP 112.110 " Preservative Treatments for Timber used in Building ".

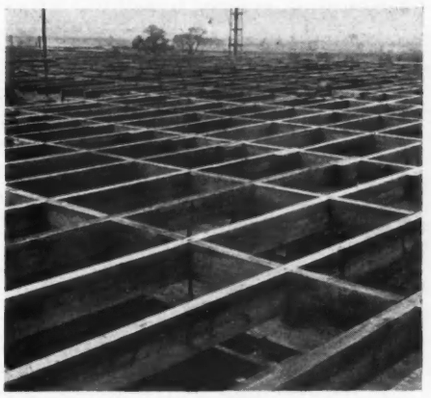
PRESERVATIVE TREATMENT AND GLUING

The increasing development in recent years o timber engineering has brought with it a growing recognition of the usefulness of preservative treatments as a means of improving, where necessary, the long term durability of the

Stables built of treated timber.

(Left) Ski judges' stand. The laminated beams are of timber treated with a water-borne preservative before gluing.

(Right) School roof timbers pressure-impregnated with a fire retardant.



material. Glued constructions form a high percentage of the timber engineered structures. Engineers therefore now look for specific recommendations covering combinations of timber, preservatives and glues. It is, however, a vast task to test the tremendous number of possible combinations, though a certain amount of work has been undertaken in recent years, and there is now some acceptance of the fact that consultation is desirable between architect, engineer, timber fabricator, glue and preservative manufacturer, to determine the most suitable combination of timber, glue and preservative for a new project which involves the use of glued preservative-treated timber.

The general information contained in the table should be of some assistance at this stage of development. Normally the selection of a correct glue would be based on the service conditions of the finished glued structure and the table provides a general guide on glue selection in terms of weather resistance.

Glue type	Specification	Weather resistance
Casein ..	BS 1444 Type A ..	Internal use
Urea resin ..	BS 1204 Type MR/GF	Semi-exposure
Resorcinol resin	BS 1204 Type WBP/GF	Full exposure including exposure to chemically polluted air

It may, however, not always be possible to follow the information in the table if preservative treatment is to be given. For example, the basic requirement of the glue for pressure treatment which is normally used with water-borne preservatives is that it must have sufficient resistance to withstand the treating cycle. Generally pressure treatment is not used with casein glues, the use of a urea resin glue is checked before treatment with the manufacturer and when a resorcinol resin glue is used it is desirable to ensure that full cure has taken place and to allow five to seven days seasoning time before applying treatment. Thus if pressure treatment is required it may be necessary to use a resorcinol resin glue, even though the durability provided by this type of glue is not required under actual conditions of service.

With surface or dipping treatments, provided correct gluing technique has been employed, the strength of the structures will normally be unaffected no matter which type of glue has been used.

In gluing treated timber, as opposed to treating glued timber, great care is needed in both glue selection and the use of correct gluing technique. The chemical content of some preservatives may affect the chemical reaction of the glue in certain cases. The carrier for a preservative may also affect gluing properties and, with surface-applied preservatives, drying time before gluing may have to be extended beyond that normally considered necessary. However, both glue and preservative manufacturers who have specialized in timber engineering are able to make firm recommendations and should be consulted on any such project involving the use of both glues and preservatives.

TIMBER AND FIRE

The merits of wood both as a constructional and decorative material are generally recognised, but on occasion it is condemned because it will burn and cannot be regarded as a "fireproof" material. Because wood is a combustible material and a fire of sufficient intensity and duration will eventually destroy it, it is not fireproof. There is in consequence a tendency to use incombustible materials such as steel, concrete and stone because they are regarded as fireproof and said to possess greater reliability in a fire.

In the booklet *Timber and Fire Protection*, published by the Timber Development Association, it is pointed out that no material will withstand the action of fire indefinitely. The question therefore arises as to whether these other materials, though incombustible, can be truly accepted as fireproof. Incombustibility in a material of construction is somewhat illogically valued more highly than its overall behaviour in a fire. Wood has great reliability in a fire. Its failing is that it can be ignited and that once ignited it may continue to burn and spread the fire beyond the area of origin. In short, its main drawbacks are its ignitibility and the surface spread of flame.

Though wood cannot be rendered incombustible by any technique at present in use, steps can be taken to increase its resistance to ignition. Action can be taken to delay or even prevent its active participation in a fire, minimizing structural damage by the fire and eliminating the risk of its contributing to the spread of fire. Wood is given such resistance by the application of fire-retardants. By efficient use of fire-retardants the objections to the use of wood can be overcome.

There are two main types of fire-retardants, those applied by pressure impregnation and those applied by surface application. Pressure impregnation is carried out by the vacuum pressure treatment technique normally used in the wood preservation industry. Heavy impregnation of the wood with fire-retardant chemicals means that the fire-retardant is mixed with the combustible wood substance so that it influences all stages of its combustion. Certain of the modern proprietary fire-retardants also contain combinations of fungicides and insecticides. Formulations at present favoured in Great Britain for impregnation treatments are mainly based on mono- and diammonium phosphate with proportions of ammonium sulphate, borax and fluoride, arsenate, copper and chromate preservatives. For many purposes this idea of a combined treatment is attractive.

For surface coatings, the most favoured surface fire-retardants are probably those which intumesce under flame to provide an insulating barrier between the flame and the wood. One of the best surface coatings is of the intumescent phosphate resin type.

Although it is not easy to extract from treated wood a fire-retardant applied by pressure impregnation, the question of "leaching" should not be forgotten and treated wood used in the open should be protected from rain by covering it with a paint of low combustibility. The weather resistance of surface coatings varies greatly. Some are unsuitable for outdoor use but others will resist removal by scratching, flaking or mechanical damage.

In selecting a treatment it should be remembered that flame proofing either by light impregnation or by surface coating will usually be adequate for lightweight and decorative wood, plywood and wallboard where the risk is of ignition from a fairly small source rather than of exposure to a sustained fire of major proportions. Such conditions are found in exhibition stands, hutments, hotels, office buildings, hospitals, schools and theatres. Where there is a risk of intense and prolonged fire in other adjoining materials—e.g. structural timbers in warehouses, factories, ships, piers, garages and hangars, or where, as in mining timbers, there is a danger of mechanical damage splintering the wood—"full fire-proofing" by pressure impregnation is desirable. Normally it is the heavy structural and load bearing timbers that call for maximum fire resistance protection. In such cases it is also important that a suitable design and method of construction should be used.

CONCLUSION

Quite apart from the generally accepted traditional uses of timber for building and constructional purposes, the development of timber engineering in Great Britain has opened up new fields for the employment of timber. New methods of protection against fire, rot and insect pests will undoubtedly be found, thus extending the life of already established timbers and enabling species not hitherto suitable to be used. Gluing techniques will advance so that there will be a great extension in the art of fabricating shapes in timber which will reduce or perhaps even eliminate other forms of fastening. With proper preservative treatment there is a vast new field open to the timber engineer.

Land Reclamation for Agricultural Use

Land reclamation involves bringing into use land which is otherwise derelict and useless because of constant or intermittent flooding. Though land may be reclaimed for other purposes, in East Anglia the emphasis is on making the land fit for agriculture.

By K. E. Cotton, M.B.E., M.I.Mun.E., M.I.W.E.

Chief Engineer to the East Suffolk and Norfolk River Board

It is well known that work of draining the Fens in Eastern England began under the Stuarts during the 17th century but was interrupted by the Civil War in 1643. The work was continued under the Commonwealth (1648-60) when the eminent Dutch engineer Vermuyden carried out work on behalf of Francis, Earl of Bedford. In 1656 the New Bedford River and the sluices at Earith and Denver were constructed.

However, it seems probable that in the eastern part of Norfolk early forms of reclamation were carried out prior to the 11th century on the tidal portion of the River Bure. The bridge and causeway at Acle is believed to have been repaired in 1101 and the tide was said to have been limited to a channel, the marshes were embanked and firm land created behind the walls. In 1712 the proprietors of the River Waveney embanked Lake Lothing, which is the tidal portion of the Waveney, on which Lowestoft now stands.

Since these early beginnings the work of land reclamation has continued in a constantly changing pattern as new ideas and methods are introduced. Basically, however, the work remains the same, namely, the protection of land against flooding and the proper drainage of the land protected.

Administration

Under the Land Drainage Act 1930, the administration of Land Drainage was entrusted to Catchment Boards which covered a large proportion of England and Wales. In 1948 the River Board Act set up the present River Boards which, in many cases, amalgamated Catchment Board Areas.

These River Boards control land drainage, fisheries, pollution and water conservation. The area covered by the East Suffolk and Norfolk River Board contains internal drainage boards which control local drainage matters in much the same way as a rural district council controls local government affairs within the framework of the county councils. Funds for carrying out the functions of a river board are obtained by precepting on county councils, county boroughs, and internal drainage boards. Grants for land drainage improvements are made by the Ministry of Agriculture, Fisheries and Food to both river boards and internal drainage boards. In the latter case the amount of grant under the Agriculture Act 1937 is 50 per cent. Grants of a similar amount may be obtained for a private drainage scheme through an internal drainage board.

It is usual for schemes of land reclamation, underdrainage, ploughing grants to be submitted through the local agricultural committee.

Methods of Protection

The first stage of reclamation is to give adequate protection against flooding. Along the rivers, tidal or otherwise, this protection is usually given by the building of clay banks or walls to a height sufficient to contain the flood. Wherever possible the materials for the bank are obtained locally by digging a "soke-dyke" on the marshes behind the wall and using the material excavated to build up the wall. Where the material from the adjoining marshes is unsuitable for use, then the material has to be imported either overland or by wherries operating in the river. Obviously considerable extra expense is involved if the material has to be imported. The clay banks are surfaced with top soil and sown with grass seed.

It is important to use only suitable materials, particularly where the protection is required against brackish (salt) water. Pervious, friable materials soon erode, developing into major breaches and offering little protection against continual seepage.

Where site conditions are bad it is often necessary to give added protection by piling along the river frontage. This is usually required on navigable rivers where the piling gives added protection against the erosion caused by the wash of the boats. Piling usually consists of timber or interlocking steel supported with walings held back by steel tie rods secured to anchor blocks in the clay wall.

Where low-lying coastal areas are to be protected, the defences required are of an entirely different character as here protection has to be provided against the direct onslaught of the sea. Generally in such cases the defences consist of reinforced concrete sea walls carried on bearing piles and with interlocking steel toe piles to prevent under-scour. A system of groyning on the beach is usually incorporated with such defences. These groynes are designed to maintain the beach and so provide additional protection to the defences.

Another form of defence against the sea, and perhaps the oldest form of defence still in use, consists of the sandhills planted with marram grass. These hills "grow" as the grass first collects windborne sand and then grows up through the sand collected.

Land Drainage

One of the earliest forms of drainage was by windmill and examination of ordnance maps of Norfolk will show as many as 12 within an area of a square mile. The disadvantage of this form of drainage was the comparatively small output when raising water a matter of 9 ft against a tidal head in the river. Use of the windmill was of course restricted by wind conditions, and it was therefore not very easy to have a controlled water level. Some levels were drained by sluices but this gave only limited benefit as to operate they were dependent on tide conditions to provide the necessary head for discharge.

The introduction of the steam engine brought about changes in land drainage. In some cases the steam engine was arranged to drive the old windmill scoop wheel, while in others a turbine was incorporated.

Later still there came the oil engine, which again in some cases was linked to the turbine of the steam engine. About 1936 it became apparent that the costly foundations of oil or diesel engines could be avoided by the use of an electric motor driving an axial flow pump. The unit is compact and the working parts small and light compared to the heavy diesel plant; this permits the unit to be installed in a relatively small and inexpensive building.

The electrically driven unit is being installed in this area right up to the present time.

Floating Pumping Stations

In the last few years a new type of pumping station has been introduced, as shown in Fig. 1 below.

This consists of a cylindrical or rectangular pontoon moored in the watercourse which is to be the main feed drain to the pump. The pontoon is connected to a fixed bulkhead plate by the delivery pipe which has two swivel joints introduced in it, thus allowing the pontoon to operate with the water levels through a range of approximately 8 ft. From the bulkhead plate, a length of pipe with a tidal flap at the outlet end and normal discharge apron completes the installation Where possible, the site is chosen to utilize existing power lines, power connection to the pontoon being made by means of a flexible five-core armoured cable.

One or more axial-flow pumps are installed in the pontoon mounted in line with the motor and connected through pipework to the outside swivel pipe. The pontoon is totally enclosed and access is made through an inspection hatch. Provision is also made for the removal of the plant and equipment by taking out a panel of the roof.

The pontoon is of welded plate construction and, as a precaution against corrosion, it can be zinc sprayed, coated with bitumastic paint and cathodically protected.

The water intake can be arranged to suit site conditions. Where the pontoon floats across the drain the intakes are in the sides and if in line with the drain the intake is at the rear. Intakes are protected by removable screens which automatjcally receive a back flush of water when the pump stops thus clearing the screen of floating debris.

The starters and all electrical equipment are installed in the pontoon and the plant is fully automatic, the pontoon acting as the float for automatic operation with sliding contacts operating the necessary relays. In the interests of economy the plant is normally operated during "off-peak" hours with control by means of a time switch, but in the event of excessive rain and the level of water rising to danger conditions

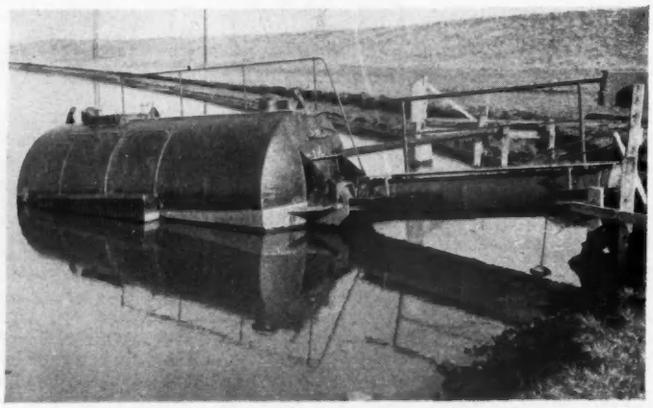


Fig. 1 Floating pumping station, showing the flexible pipe connection to the outlet.

Paper presented to the Engineering Section of the British Association, at Norwich, September 1961.

then a further relay over-rides the time switch and the pump operates.

In the event of abnormal flooding conditions and the pontoon reaching its limit of travel, it automatically disconnects at the discharge pipe near the bulkhead plate and is allowed to float freely. A chain anchor prevents the pontoon floating away from the site.

While this installation is a comparatively new innovation it would appear to have the following advantages over the orthodox station:—

1. A saving in initial cost where ground conditions necessitate expensive piled foundations to take the orthodox brick and concrete structure.
2. The floating station is prefabricated in the works and delivered to site complete for launching.
3. In the event of changes in drainage policy the plant can be moved to another site, providing electricity is or can be made available.
4. A certain amount of standardization with regard to components can be introduced.

Design of a Reclamation Scheme

Physical Considerations.—In considering a reclamation scheme, the whole of the existing conditions are surveyed and a complete set of levels of the area obtained. A particular note is made of the nature of the upland and lowland areas to be drained; the adequacy of the defences against flooding; the intended use of the land; rainfall records and last, but not least, the boundaries of the various owners and occupiers.

Site for Pumping Station.—Other things being equal, the site for the pumping station is usually selected at the lowest point on the area to be drained. However, the following important factors must be taken into account before a final decision is made:—

Nature of Ground.—To determine conditions for foundations, a series of bores are taken and the various strata encountered recorded, often down to a depth of 40 ft below the marsh level. In this area it is not unusual for the boreholes to show peat down to a depth of 20 ft, and as many of the marshes in this area are several feet below mean sea level, it means that very often the foundation piles to pumping stations have to be taken down to levels in the region of 30 ft below Ordnance Datum, Newlyn (ODN).

Access.—Access roads (or "driftways") are often few and far between and at certain times of the year quite unusable. It is important to have reasonable access to the pumping station at all times to carry out maintenance and to deal with major repairs.

Power Supply.—Today, with the almost universal use of electrically operated plants, the proximity of an existing supply is very important. It is not unusual for the cost to be as much as £1,000 for bringing the supply to an isolated site.

Design of Pumping Station.—Depending on ground conditions it is usually found necessary to found the station on bearing piles of concrete or timber, usually 9 in by 9 in in section. These are driven to a "set" of approximately $\frac{1}{8}$ in per blow when driven with winch-operated drop hammer weighing 15 cwt and falling 3 ft.

A typical type of station is illustrated in Fig. 2. The intake of the pump is constructed in interlocking steel sheet piling over which there is the concrete floor and the brick building shown. The axial flow pump suspended in the well raises the water, and discharge to the river takes place through the cast iron pipe. The tidal flap at the river end prevents the water from flowing back. The pump is mounted on "trunnions" which permits the pump to be swung into a horizontal position in a very short time to permit examination of the impeller.

As the cost of electricity is something of the order of one-sixth for use on "off peak" periods as against day-time use, the pump is controlled by "no-flote" electrodes and a time switch. The electrodes can be set to allow the pump to cut in at any desired level. A screen is erected across the entrance to the well to prevent debris from entering the pump. In some cases a secondary screen has been found necessary a short distance along the main drain to collect the larger debris.

Pump Size.—In order to calculate the size of pump required, it is first necessary to know the catchment area to be drained. This will be divided between upland and lowland areas. Let us take as an example a case for which a pump has recently been designed adjoining one of the Suffolk rivers.

Catchment Areas

Lowland	.. .. ..	475 acres
Upland	.. .. ..	995 acres

We use the following impermeability factors:

Lowland	.. .. ..	0·33
Upland	.. .. ..	0·20

This impermeability factor may be defined as the proportion of the full rainfall falling on a given area which will reach the drainage channel. Assuming rainfall of 1 in in 12 hours the run off will be

Lowland	0·33 × 475 × 3,630	= 574,750 cu. ft
Upland	0·20 × 995 × 3,630	= 722,340 cu. ft
Total run off		1,297,090 cu. ft

From this figure can be deducted the storage capacity of the marsh drains, which is arrived at by taking the volume in all the drains in the area to be drained between normal pumped water level and the maximum permissible top water level. In the case under consideration this amounts to 583,240 cu. ft. The quantity to be pumped is therefore 713,850 cu. ft and this quantity is to be pumped in 11 hours (that is, during the 12 hour "off peak" period from 7 pm to 7 am, allowing $\frac{1}{2}$ hour tolerance at each end of the period). Pumping must therefore be at the rate of 18 cu. ft per sec.

Drain Design.—To give effective drainage to the marshes it is usually considered necessary to have the water level at least 3 ft below the marsh level. This will permit satisfactory underdrainage at a depth suitable for agriculture.

In the case under consideration, the marsh level near the pump is − 2·00 ODN and to give the required 3 ft "freeboard" the high water level required will be − 5·00 ODN. For an automatically operated pump a minimum range of operation of 18 in is found desirable and therefore the low water level will be − 6·50 ODN. To operate satisfactorily a depth of water at the pump of at least 2 ft is required and this allows for reduction of waterway by weeds and trash collecting on the screen and also for possible future marsh shrinkage. The level of the bed of the drain at the pump will therefore be − 8·50 ODN.

The pump capacity having been determined at 18 cusecs, this maximum flow is apportioned between the various main drains leading to the pump according to the respective areas drained.

Trial sections are then drawn along these drains and cross-sections calculated bearing in mind the discharge and water levels required and the desirability of keeping the water velocity in the region of 1 ft per sec to minimize scour. Side slopes of the drain banks vary between 1 : 1 and 2 : 1 depending on the nature of the ground.

As a general rule drains are excavated by means of a mechanical excavator usually fitted with a dragline bucket of capacity $\frac{1}{2}$ to $\frac{3}{4}$ cu. yd, dependent on the size of the drain to be constructed. The machine usually operates on stout timber mats which can be moved ahead of the machine by attaching a sling chain to rings provided in the mats. The material excavated is deposited in an even line about 15 ft back from the edge of the drain ready to be levelled by bulldozer when sufficiently dry.

Other types of excavating machinery are now being developed and used successfully. Various forms of tractor-mounted shovels are available and can be used with advantage under certain site conditions. Some types lift and carry the spoil away for immediate spreading; others operate where trees or other vegetation make the use of a dragline excavator impracticable.

Bridges and Culverts.—The drainage pattern used in East Anglia makes numerous bridges and culverts necessary for road and foot traffic.

From a drainage point of view, bridges are preferred as they offer little or no restrictions to flow. When the span becomes excessive, bridges become expensive and culverts are used. Generally, a 25 ft span for bridges is considered a reasonable limit. Culverts are frequently used where it is desired to incorporate water level control boards as these can be conveniently housed in the culvert headwalls.

Design loads for bridges depends on the intended use, but the minimum would be a distributed load of 100 lb per sq. ft as representing the weight of a tightly packed herd of cows. Note that strong balustrade supports are required when the bridge is intended for a cattle crossing.

The bridges are usually of the simple flat slab construction in reinforced concrete; on the longer spans steel beams are used to support precast concrete deck beams or timber sleepers.

Culverts to be used as crossings for heavy farm machinery are usually constructed with reinforced concrete pipes (diameters vary from 18 in to 48 in) laid on and protected with concrete. The pipes terminate in reinforced concrete headwalls carried well into the drain banks. In bad ground the foundations are protected from under-scour by timber toe piling driven across the bed of the drain. A cheaper form of headwall is sometimes built using 3 in by 9 in timber piles supported by a timber

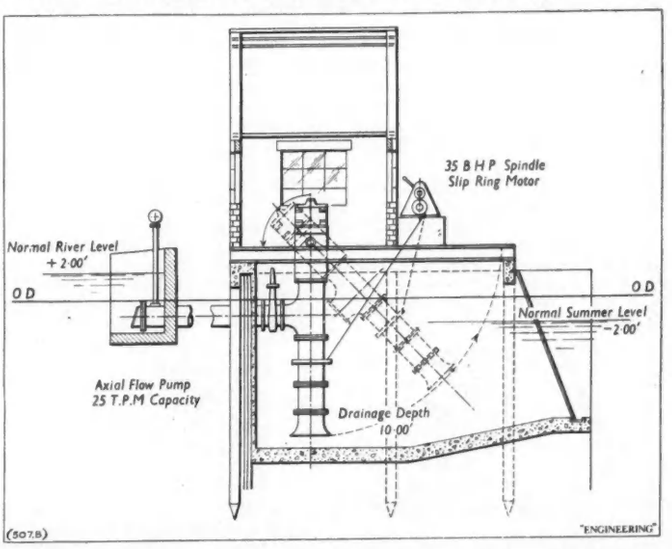


Fig. 2 Section through a typical pumping station showing supporting piling.

walling and the two headwalls anchored to each other by means of steel tie rods.

The crossings over the pipes are often surfaced with hardcore to form a hard surface for vehicles.

Land Uses

Originally most of the marsh areas of East Anglia were reclaimed for stock grazing but in recent years it has been found that the soil is ideal for raising crops such as beans, potatoes, wheat, kale or even sugar beet. This change has given rise to more intensive land drainage.

One case I have in mind is of an area of about 260 acres which had lain derelict for a long time and had never been used previously for arable crops. The method adopted in December, 1958, was to immediately set about disposing of all surface water and ploughing up as much as possible of the land. Analysis showed the soil to be extremely short of phosphate but the position in regard to lime and potash was satisfactory.

In the first year, 70 acres were cropped with barley undersown with Italian ryegrass. From this area an average yield of 16 coomb per acre was obtained with an application of 3 cwt of superphosphate and 3 cwt of sulphate of ammonia per acre. The Italian ryegrass was cut for silage in the following year after applying 2 cwt of superphosphate and 4 cwt of sulphate of ammonia. After taking the silage, a seed crop of 5 cwt of clean seed per acre was taken.

On the rest of the area broad beans were grown and yielded 9 tons per acre, though at first difficulty was experienced with wireworm attacks. A further acreage was drilled with wheat which yielded 15 sacks per acre with an application of 3 cwt of superphosphate and 4 cwt of sulphate of ammonia.

In 1960 a crop of barley and potatoes was grown on these marshes.

The owner freely admits that it is essential to have first class drainage and, in addition to lowering the water table to about 5 ft below marsh level by means of an improved drainage channel and electric pump automatically operated, he has since carried out extensive tile drain schemes.

Maintenance

River Banks.—The area of land occupied by river banks is quite considerable and often amounts to 8 to 10 acres per mile of river on one bank alone. Proper management of these banks is desirable at low cost.

In recent bank reconstruction schemes the aim has been to obtain a front slope and a back slope of 2 : 1 which can if necessary be kept mown. The banks have been carefully cultivated and sown with a recommended grass seed mixture. This in general consists of a mixture as follows: Perennial Rye 28 per cent, Cocksfoot 58 per cent, Wild White Clover 3 per cent, and White Clover 11 per cent.

When a river wall has become properly established, I am strongly in favour of grazing by small cattle or sheep, provided grazing is not allowed when conditions are exceptionally wet. It has been found that cattle will walk close to the base of the front and the rear of the wall, and it is remarkable how rat and mole holes—and also holes made by the latest menace in this area, the Coypu—become jammed in so that seepage is reduced to a minimum.

Where walls are not so far being grazed an attempt is being made to remove any weed growth by spraying and walls are being mown to try to establish a good growth of grass.

The presence of long rank grass, reeds and brambles makes it practically impossible to locate leaks which, apart from necessitating additional pumping costs, can cause a serious breach in the defences if left unattended.

Drains.—No reclamation scheme will succeed if the maintenance of the drains is neglected.

Each year it is necessary to remove weed growth from the drains and this is done by a gang using a chrome, a long handled fork on which the tines are bent at right-angles. Where the edge of the drain has become trodden in the edge is recut to a neat line.

Experimental Work.—In conjunction with the Ministry of Agriculture Fisheries and Food, trials are being carried out on a section of clay wall at Reydon in Suffolk. The backslope of the bank was carefully prepared with suitable top soil and raked over, Aberystwyth S23 grass seed being sown at the rate of 50 lb per acre. Certified seed was used and the certificate obtained.

When sowing, Fisons No. 41 fertilizer was applied at 5 lb per acre, the seeds and fertilizers being raked in together.

The demonstration length was divided into four parts to be (i) grazed, (ii) mown annually, (iii) mown two or three times a year, and (iv) neither grazed or mown.

It will be some time before any definite conclusions can be reached but the grass has grown well, giving good cover to the slope of the wall.

The 1953 Surge.—On the night of 30-31 January, 1953, a surge was experienced on the East Coast when a high tide reached a level 7 ft above that predicted. Extensive damage was done to both sea and river defences and a very large number of breaches, both large and small, occurred. About 26,000 acres of agricultural land were flooded.

This surge necessitated maintenance work, reconstructions and improvements on a very large scale.

The initial sealing of the breaches was carried out by filling sand bags with material taken from the adjoining saltings, though in some cases where material was not readily available bags were filled at remote sites and transported to the breaches. The general method used was to lay chain link fencing in the breaches and, as the bags were thrown in, the fencing was wired to completely surround the bags which were securely wired and staked down. It was necessary to have a large force of men available to get all the material ready so that sealing could be completed between tides.

At Wells in Norfolk, where the breaches were deep, a suction dredger was used to pump sand into the breaches after chalk and slag had been deposited.

Fig. 3 Reconstruction of a river wall using ¾ cu. yd and ⅜ cu. yd draglines.

New Standards.—In most cases the necessary repairs on clay walls were extended to make the banks 1 ft higher and 1 ft wider on the crest, with a 2 : 1 back slope and a minimum 25 ft width of folding, with an absolute maximum depth of delph borrow pit below marsh level of 5 ft.

The existing soke drain was filled in and a new dyke cut further back on the marsh. It was found that the very greatest care had to be exercised in clearing out all slurry from the old soke dyke before filling and in keeping it pumped perfectly dry during the whole filling process. This task probably represented one of the greatest practical difficulties of the reconstruction works and was a constant problem calling for a great variety of solutions on the various sites.

The length of wall over which such reconstruction was necessary was 25 miles, though over some of this length it was considered desirable to rebuild the wall to a higher standard. A typical job in progress is illustrated in Fig. 3. In general, the crest of the wall was some 6 ft wide as reconstructed and at a height of about 12 ft above the marsh.

The top 2 to 3 ft of the marsh where a new delph was constructed was usually good clay suitable for wall building. The first stage in the construction of the new walls was to fill in the old delph. This was done by bulldozers. To complete the important operation of pumping the old delph dry before filling it, the delph was first dredged and all surplus mud removed to get down to a reasonably firm bottom. The delph was pumped out in sections with diaphragm pumps before in-filling.

The next operation was to strip the old wall. This was done by bulldozers. The turf was stripped off and pushed on to the saltings for possible re-use and bad material in the wall was removed by cutting vertically down from the crest to folding level. It was evident that the old walls had been heightened by draglines only, for the line of added material, which was heavily fissured, was clearly visible when the wall was cut down.

The wall was roughly built by D8 bulldozers, the passage of the machines helping to consolidate the core of the wall. A small dragline was then run along the top of the wall to trim the slope of the wall, followed by more consolidation by bulldozers. The whole of the back of the wall was rolled by bulldozers.

Costs

It is felt that any attempt to provide costs of the various works involved in reclamation would prove misleading as (*a*) each site provides a different problem and (*b*) accessibility of site and ground conditions vary so much on individual sites.

It may be of interest, however, to quote a few average prices of the various operations, as follows:—

Clay walls	£10 per yard linear
Concrete sea wall with steel piled toe	£34 per foot linear
Concrete block revetment..	£2 per yard linear
Electrically operated pumping station, including building, piled well, and outfall	£10,000
Floating electrical plant ..	£9,000
Cutting of new drain, 16 ft top width by 6 ft deep ..	10*s* per yard linear
Deepening and widening existing drain	5*s* per yard linear
24 in piped culvert with wing walls, etc.	£350
Control sluice for small marsh drains	£175
Average cost of ploughing and cultivation	£20 per acre

Acknowledgements.—Acknowledgement is recorded of my thanks to Mr. S. M. Hawes, A.C.G.I., B.Sc., A.M.I.C.E., consulting engineer, for the information on the floating pump. I also acknowledge the willing assistance given by my staff in the preparation of this paper.

TORQUE MEASUREMENT UNIT

Transistorized

EMPLOYING a meter calibrated directly in angular degrees, this new method of torque measurement is based on the indication of torsion under dynamic load.

The compact fully-transistorized meter indicates the phase difference between any two signals fed to it. It is also able to compare the phase of signals from two transducers having outputs between 0·03 and 300V rms. With balanced signals guaranteed accuracy above 10c/s is better than $\pm 3°$ but it is reported that readings accurate to 1° are often possible.

The meter range is 1c/s to 25 Kc/s, equal to 60 to 1,500,000 rpm at one pulse per revolution. By providing several pulses per revolution the bottom limit may be extended.

Phototransistor pickups, focused on rotating black and white discs, provide signals for the phase meter which may be battery or mains operated. When the rotating member is enclosed or photocells cannot be easily used, electro-

magnetic pickups may be employed.

To measure the torque a phase-angle reading is taken with the shafting rotating without load. The amount of twisting which occurs when load is applied is indicated in degrees. *Dawe Instruments Limited, Western Avenue, Acton, London W3.*

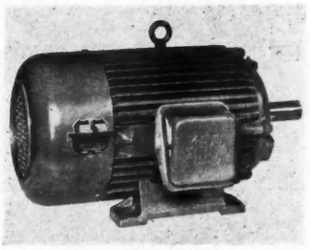
FAN-COOLED MOTOR

Increased Output or Reduced Temperature

THE Crypto-D range of totally-enclosed fan-cooled cage rotor motors is claimed to offer outputs comparatively higher than those of other British motors. They are said to be suited for all applications, with outstanding advantages where smaller, lighter motors are desirable, as in machine tool manufacture, and where reduced rotor inertia is important. As a corollary the motors tend to give quicker starting.

Dimensionally to BS 2960 Part 2 and IEC recommendations, the units are capable of increased outputs or reduced temperature rise. These results are attributed to better heat transfer and improvements in insulation. The increased output is available with performance to BS 2613, Class E insulation, 65°C rise (40°C ambient temperature) with continuous rating. All materials conform to BS specifications.

The terminals are of the stud type with adequate clearances between phases and to earth. They are readily accessible and are housed in a spacious terminal



box with cable inlet adjustable through angles of 90°. On all sizes of machines the ball bearings are of the standard metric type, pre-loaded for optimum performance. The bearings are charged with high-grade lithium-based grease and lubrication is said to be infrequent.

Ventilating fans are of aero-dynamic design to provide maximum cooling with minimum turbulence and noise. The rotors are dynamically balanced. Outputs range from 0·5 to 50 hp. Designs include 2-pole 3,000 rpm, 4-pole 1,500 rpm, 6-pole 1,000 rpm, and 8-pole 750 rpm motors. *Lancashire Dynamo and Crypto Limited, Acton Lane, Willesden, London NW10.*

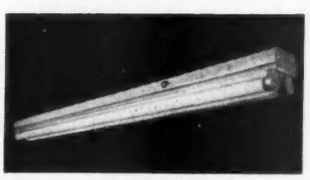
FLUORESCENT LIGHTING FITTINGS

Sprung Lampholders

KNOWN as the Durham range, new fluorescent lighting fittings have been introduced for commercial and decorative applications.

All these fittings, which are based on standard single- or twin-lamp spines, incorporate control gear and spring-mounted lampholders ready wired. Every item in the range is available in a 4 ft, 5 ft, or 8 ft version (corresponding to 40, 80, and 125 W), and with Quick-start or Switchstart control gear. Spines have two suspension holes. The same channel sections are used for all fittings, whether single or twin-lamp and irrespective of length. All spines have flat vertical ends.

The bi-pin lampholders, which completely enclose the lamp cap, are attached to the fitting by flat-strip springs. Ample movement at the lampholders makes re-lamping easy. It has been possible to use a spring which holds the lamp positively and provides adequate pressure at the electrical contacts. The phosphor-bronze spring



assemblies normally used have been replaced by simple contacts, these it is claimed give a lower millivolt drop in the circuit, which is of assistance to starting. A safety feature of the lampholder is that it is impossible to insert one pin of a bi-pin lamp by mistake. The fittings may be re-lamped from either end.

Control gear and components comply with British Standards. Permaset fixed-voltage chokes are fitted. Starter switches, mounted in the sides of the spines, are immediately accessible. A fused terminal block gives individual fitting protection; the cartridge fuse is easily replaceable. Fittings in position may, it is reported, be rapidly converted, for example from plain batten (illustrated) or reflector to totally-enclosed diffuser. *Ekco-Ensign Electric Limited, 45 Essex Street, London WC2.*

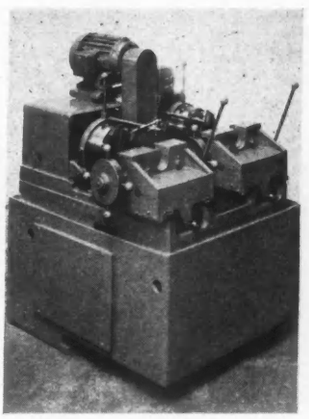
THREADING MACHINE

Double Spindle

FITTED with Lanco R type tangential dieheads, the double-spindle MB threading machine has a maximum capacity of 1½ in bolts and pipes. Alternative heads available include those for pipe and nipple work and nominal pipe sizes up to 2 in bore.

The machine is based on the 1 in and 1½ in single-spindle MB machine introduced a few years ago, but now incorporates a number of refinements. The headstock is totally enclosed. A 5 h.p motor provides power to both spindles, with a choice of eight spindle speeds by means of pick-off gear. Each spindle can run at a different speed but both run in the same direction. All shafts are ball-bearing mounted with the spindle in bronze bushes.

The Landis dieheads are provided with an automatic trip mechanism which is adjusted to provide varying thread lengths. The bed of the machine is reported to be exceptionally rigid and is fitted with hardened and ground replaceable bedways keyed for accurate align-



ment. The carriage front is fully adjustable in both the vertical and horizontal planes. This permits the work to be precisely aligned with the cutting tool and the diehead, which contributes, it is said, to high-quality threads and exceptional tool life. *Landis Machine-Maiden Limited, Hyde, Cheshire.*

RAIL DE-STRESSING UNIT

Air-Propane Burners

FOR destressing continuously-welded rails more cheaply and efficiently air-propane burners have been introduced.

Propane has proved successful for this application due, it is reported, to the ease with which it may be handled and its high vapour pressure at low temperatures. The rail is warmed to between 65 and 80° F before fastening down. By anchoring at this temperature it is found that the rail is best suited to deal with the varying stresses of expansion and contraction to which the track is subject during the different seasons.

The unit comprises a trolley supporting four heating muffles and 100 lb propane cylinders. Two air-propane burners are housed in each muffle. Destressing is effected by slowly moving the trolley along the track with the flame producing a temperature of about 1,900 to 2,000° C. Heating is commenced at the free end of the rail and is completed in two passes. Temperature rise is ascertained by accurately measuring the length of the

rail; as an example a 500 yard length of continuously-welded rail will expand by 4½ in when the temperature is raised from 35 to 75° F. The time required to bring about this temperature rise, with one trolley in operation, would be between 1¼ and 1½ hours.

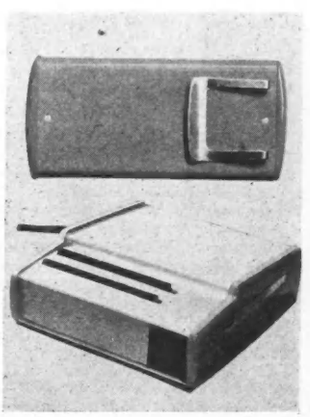
Propane consumption per burner is 9 lb/hr at 20 lb per sq. in and 11 lb/hr at 30 lb per sq. in at which pressures the burners will work efficiently. The number of burners fed from a 100 lb propane cylinder is two in some applications and one in others. *The British Oxygen Company Limited, Bridgewater House, Cleveland Row, St. James's, London SW1.*

PERSONAL CALL SYSTEM

Individual Receiver

CONTACTING individuals is possible with the audio-frequency induction system, transmitting calls from one or more control units to pocket receivers.

It is reported that there is no limit to the size of the reception area and that most buildings can be adequately served by one transmitter feeding a wire aerial. Two networks are available, the smaller catering for 16 receivers or less, and the bigger for up to 120. Larger installations can be made to order. The control unit is designed for desk operation. Signals are transmitted automatically when the key is pressed. There are six types of receiver, three each for the small and the large systems. These cater respectively for sound, light or both. Two different signals can be transmitted, lasting from 5 to 30 sec; these are an audible bleep and a flashing light beamed towards the eye. The bleep may be followed by a spoken message of any duration. To hear this the receiver is removed from the breast pocket, where it is normally carried, and held to the ear.

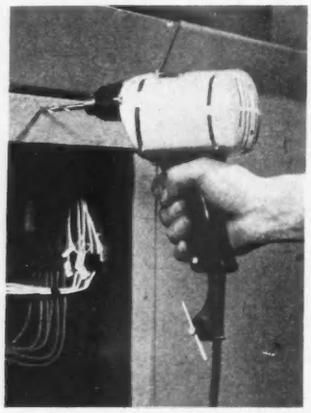


The transmitter is operated on 110 or 200/250 V 50/60 cycles single-phase supply. The power consumption is of the system 260 W.

The illustrations show (top) the pocket receiver, which weighs less than 6 oz, and (below) the control unit operated by lettered keys. *Westrex Company Limited, Coles Green Road, London NW2.*

ELECTRIC HAND DRILL

Automatic Cut-Out



KNOWN as the 77 series, this new neonic ¼ in industrial hand drill is claimed to have overcome the problem of providing an overload factor in a portable drill of restricted size. There is reported to be an improvement in handling characteristics, together with a higher penetration rate.

These results have been made possible, it is said, by a newly-developed 350 W cartridge motor, of ½ hp, provided with an automatic overload cut-out. The motor gives a high torque over the chuck speed range of 2,350 rpm running light and reducing to 1,400 rpm at full load. This speed range is claimed to be the most satisfactory for drilling in a wide range of materials.

A thermal switch, situated at the rear of the motor, functions as an automatic cut-out in the event of overloading. This can be reset in a matter of seconds. A device is incorporated to warn the user if the unit is not earthed or correctly wired to the mains. Twin ball bearings are provided on the chuck spindle, helical reduction gears are employed, and the armature runs on ball bearings.

Drilling capacity is ¼ in in steel and ⅞ in in hardwood. Current requirements are 350 W. The weight is 4 lb 2 oz. *S. N. Bridges and Company Limited, York Road, London SW11.*

ELECTRICALLY DRIVEN WINCH

With Warping Bollards

THIS electrically-driven winch has four barrels in line and warping bollards at the ends. Each barrel is free on the main shaft and is independently operated by means of a dog clutch.

The inner barrels, 20 in in diameter and 24 in long, will accommodate 1,000 ft of ⅞ in diameter wire rope in six laps and will give a maximum pull of 6 tons from the top layers. The outer barrels, of similar diameter but with a length of 12 in, will accommodate 500 ft of ¾ in diameter wire, also in six laps, and will impart a pull on the rope of 5 tons, measured from the top layer. Both of the pulls stated are obtainable from one barrel, one at a time. The maximum rope speed is 50 ft per minute.

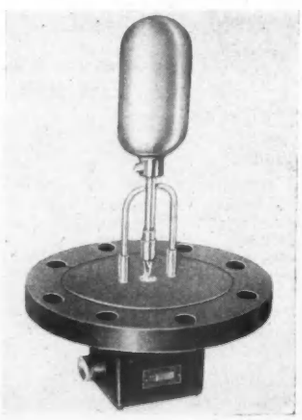
A 38 hp motor, supplied with current at 415V 3 phase 40 cycles, drives through a double-reduction spur gear. All gearing is totally enclosed in oil-tight gear cases. The main shaft of the winch runs in gunmetal bearings throughout; these are grease lubricated. All other reduction shafts are carried on ball or roller bearings. The warping ends, 18 in in diameter, with plain and parallel waists, are keyed to the main shaft and revolve during the time the motor is energized.

The motor is of the marine pattern, totally enclosed. It is complete with self-contained magnetic disc brakes. Control is effected manually through a cam-type controller; there are four notches of plain series control in either direction. The operating lever may be locked in the "in" or "out" positions and the barrel can be retained by the screw-operated friction-lined brake.

The total weight is 7½ tons. Length overall is 16 ft 4 in and the width approximately 9 ft. *Richard C. Gibbins and Company Limited, Berkley Street, Birmingham 1.*

LIQUID-LEVEL ALARM SWITCH

Stainless Steel



DESIGNATED Model 26S, this stainless-steel liquid-level alarm switch is considered to be of particular interest to the food-processing industry.

The switch is an addition to the makers' range of packless flexible-shaft level controllers. The carbon-steel flange of the switch is clad with a stainless-steel plate, presenting to the process an unbroken surface to which deposits will not adhere. Displacer, stop arms and flexible shaft are also of stainless steel.

With no rubbing parts and capable of direct or reverse action, the switch is claimed to be easy to install. Operation is by a change in the buoyancy of the displacer and not by the movement of a float on a changing liquid level. Any displacer motion is transmitted to the micro-switch by a stiff tongue within the flexible shaft. Stop arms are provided to ensure that the stress in the flexible shaft is kept within the elastic limit. The micro-switch is operated by a buoyancy change of less than 6 oz, equivalent to a level change of approximately ½ in in a liquid with unit specific gravity.

The switch operates at process temperatures from 65 to 350°F, with adequate ventilation. *Associated Electrical Industries Limited, Crown House, Aldwych, London WC2.*

SMOKE-DENSITY INDICATOR

Photoelectric

VISUAL and audible warning, when smoke exceeds a predetermined density, is given by the Type CCSI photoelectric smoke-density indicator.

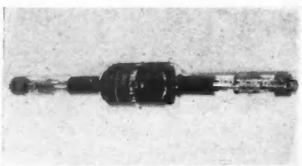
Smoke density is continuously recorded on a 10 in meter, illustrated, calibrated in percentage obscuration. A beam of light is projected across the flue or chimney, which may be of any size, to a photocell receiver. Breaking of the light beam by the smoke causes the cell to emit a current which is directly proportional to the obscuration of the beam.

Continuous indication recorders can be supplied to give a permanent record of combustion conditions on a 30-day roll or on a daily disc. Alternatively, a recorder is available which shows only the time and duration of the emission of excessive smoke.

Projector and receiver units are preferably sited in areas of negative pressure, as for example on the input side of an induced-draught fan or at the base of a stack. Such location enables clean air to be drawn through the air-purging orifices provided and helps to keep the optical system clean. For areas of pressure special projectors and receivers are available. Both light-beam projector and photo-cell receiver are housed in weatherproof aluminium castings. *Photoelectronics (M.O.M.) Limited, Oldfields Trading Estate, Sutton, Surrey.*

SCAN CONVERTER TUBE

Non-Destructive



THE scan converter Type K2070 is a double-ended, electrical input—electrical output, non-destructive readout storage tube and is capable of resolution in excess of 1,000 lines at 50 per cent modulation.

Primary current modulation is employed in non-equilibrium writing; either simultaneous or sequential reading and writing may be employed. Stored information can, it is claimed, be retained for hours, erased in a second, or made to decay at a controlled rate while new information is superimposed. The converter can be used for converting from one scan frequency or scan mode to another, as in wide-to-narrow bandwidth transmission and PPI to TV scan, and for data transmission and storage with random, simultaneous, and repetitive access. Half-tone operation enables transmission of video, multi-level, and time dimension information.

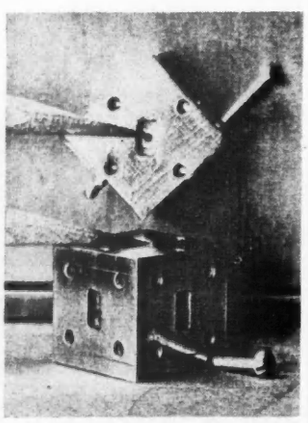
Integrating characteristics enable build-up of repetitive signals submerged in noise and identification of superimposed information. Two high-resolution opposed-on-axis electron guns are employed for writing and reading operations. Both employ electrostatic focus and magnetic deflection with provision for using magnetic focus with dynamic electrostatic focus.

The maximum accelerator and focusing electrode voltage for both the write and read gun is 4,000V dc. The overall length is 23½ in ± ½ in. The greatest diameter of the bulb is 3 in. The device operates in any position.

Maximum ratings (absolute values) for both read and write guns are: accelerator voltage 4,000 (dc); focusing electrode voltage 4,000 (dc); grid No 2 voltage 700 (dc). For both guns the negative bias voltage value is 150 (dc) and that of the positive bias 0 (dc). *Aveley Electric Limited, Ayron Road, Aveley Industrial Estate, South Ockendon, Essex.*

DISCRIMINATOR CAVITY

Frequency Stabilizer



THIS WX 4334 dual-mode transmission-type discriminator cavity frequency-stabilizing device is claimed to be suitable for such applications as parametric amplifier pumps, navigation systems, and beacon radars, where a high stable frequency source is required.

Strongly constructed, it is designed to operate at 35,000 megacycles but designs for other fixed frequencies can be supplied if required. To minimize the influence of change in ambient temperature on frequency drift the cavity is vacuum sealed and invar is employed in the construction of the unit. A change in resonant frequency of ± 8 megacycles is representative for a temperature change of 25 to 100° C.

Typical operating characteristics of this cavity include ambient temperature range of −55°C to +100° C, a loaded Q for each output of 3,000, and a frequency difference between outputs of 10 megacycles. Insertion loss input to each output is 10 dB maximum and insertion loss difference between outputs is a maximum of 1dB.

The cavity, which is shown in the illustration with a tilted mirror behind it, weighs 3·1 oz. It can be mounted in any position using a wave guide with cover flanges. *Westinghouse Electric International Company, 1 Regent Street, London SW1.*

Aggregate Plant for High Grade Concrete

Controlled from a central point, this gravel extraction plant can supply 80 cu. yd of aggregates an hour blended to any British Standard grading. Efforts have been made to minimize the effect the plant has on the neighbouring area.

UP TO DATE sand and gravel blending and grading equipment is one of the features characterizing the gravel plant opened by the Greenham Sand and Ballast Company Limited at Chertsey Lane, Staines, near London. Incorporating push-button controls, the plant has a capacity of 80 cu. yd an hour, and was manufactured by Frederick Parker Limited of Leicester to a basic design and layout by Mr. G. S. Phimister, technical director of Greenham Sand and Ballast. The sand section is by Wilkinson Rubber Linatex Limited and the electrical installation by F. Lawrence and Company (Feltham) Limited.

By means of landscaping care has been taken to fit the plant into the local scene; chutework and machinery is rubber lined wherever possible to reduce noise; and when the initial area of five acres is worked, it is intended to start filling in as soon as conditions permit. The landscaping includes a screen of flowering trees in the area of the Chertsey Lane entrance, while pale jade green has been selected as the main colour scheme for the plant.

All units on the plant are controlled from a central plant switchroom, with the exception of the clean water pump and crusher which are controlled from their locations.

Greenham say that an appreciation of the importance to the contractor producing quality concrete of the need for consistent and "tight" grading of aggregates has been the primary concern in the design and lay-out of the new plant, which produces top quality aggregates graded to meet all British Standard specifications. To ensure cleanliness, though the material passes through two 8 in gravel pumps during processing, a high-speed scrub mill has been installed. This deals with the occasional clay seams in the natural material and removes any clay left behind during uncovering operations (in some areas the overburden extends below the water table). The mill can be by-passed when the natural material is clean.

Aggregates are stored in single sizes for re-blending and a further feature is the insistence on the consistent and "loose" nature of the sand before delivery to the sand blenders, attained by dewatering the sand in one of two drainage bins, and, when it is sufficiently "dry," passing it by conveyor to the blender storage bin. This process loosens up the compaction which occurs during drainage.

Deposit.—The deposit being worked is flood-plain gravel associated with the River Thames, of the "Flint" type and known for its strength and general high quality. There is an average depth of sand and gravel of approximately 16 ft, with about 4 ft of overburden, the water table being about 3½ ft below the surface level.

Extraction.—Sand and gravel is pumped from the working face by a Gwynnes 8 in gravel pump, which is mounted inside a floating steel pontoon unit and driven by a Dorman diesel engine. Also mounted inside the pontoon is a diesel-driven winch for raising and lowering the suction pipe.

During the early stages of production, the material is pumped direct along an 8 in bore pipeline to the boiling box before flowing on to the primary screen. Later, when a sufficiently large lake has been excavated, the material from the gravel pump at the face will be discharged into barges and hauled to a barge unloading unit moored alongside the plant. Here another 8 in Gwynnes gravel pump will empty the barges and pump the material to the boiling box.

Gravel Section.—From the boiling box the material is discharged on to the primary screen (Niagara 10 ft by 5 ft double-deck vibrating type). The material rejected by the top deck (+ 1½ in) is carried by conveyor No. 1 to a 50 cu. yd capacity storage hopper for loading into lorries. The − 1½ in aggregate is retained by the bottom deck and can be fed either to a 15 cu. yd surge hopper when clean or to a 5 ft diameter Parker scrub mill when dirty. This high speed mill effectively deals with any clay particles and the clean material is discharged from either the surge hopper or the scrub mill on to conveyor No. 2, which takes it to the secondary screen (Niagara 10 ft by 5 ft three-deck vibrating type) mounted on top of the storage and blending bins. The − 1½ in/+ ¾ in material is retained by the top deck and discharged by a chute to the − 1½ in bin.

The − ¾ in/+ ⅜ in material is retained by the second deck and discharged by chute to the − ¾ in bin and the − ⅜ in/ + $\frac{3}{16}$ in material is retained by the bottom deck and discharged by chute into the − ⅜ in bin.

For final rinsing of the material, water sprays are incorporated, the water passing through the bottom deck and flumed to the side of the plant.

Sand Section.—The sand (− $\frac{3}{16}$ in) and water passing through the bottom deck of the primary screen flows to a static settling cone where the silt and dirty water passes over the weir and is returned to the pit. A 6 in Linatex sand pump extracts sand and water from the bottom of the static cone and delivers the mixture through a 6 in bore pipeline to a 24 in Linatex Separator mounted on a tower on top of two sand drainage bins.

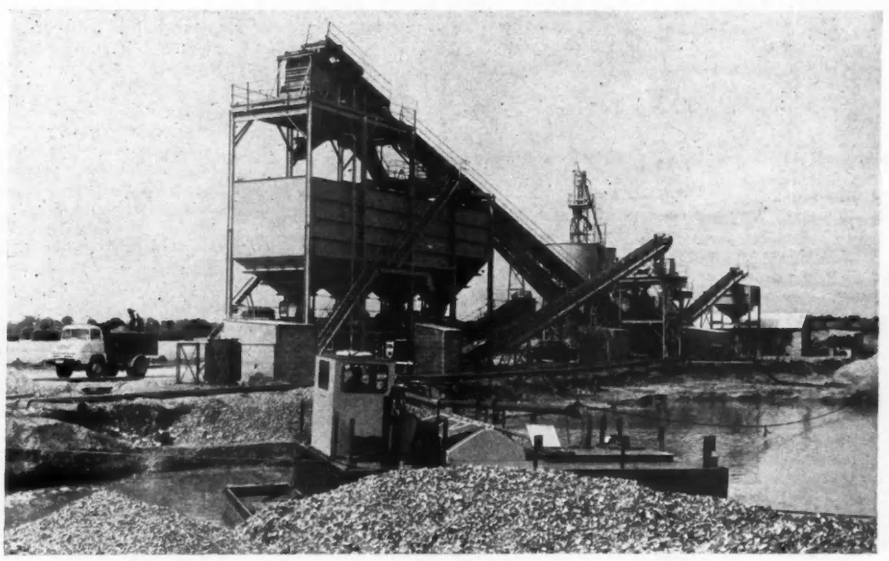
Concreting sand containing approximately 20 per cent water is discharged from the underflow box of the separator and is directed by Linatex lined chutes to one or other of these 100 cu. yd capacity circular sand drainage bins. Whilst one bin is being filled, the sand in the other is draining. Under each of the drainage bins is a belt feeder which is used to draw out the drained sand and feed it to conveyor No. 3, which takes the drained sand to the 100 cu. yd capacity sand blending bin.

Crushing.—Provision has been made for the − 1½ in/ + ¾ in material to be drawn from the − 1½ in storage and blending bin and fed to a Sheepbridge Kennedy No. 25 short head cone crusher. This crusher is set to produce − ¾ in material and is in closed circuit, the crushed material being carried by an inclined conveyor to an 8 ft 6 in by 4 ft single-deck "Gyrex" vibrating screen equipped with water sprays.

The − ¾ in/ + $\frac{3}{16}$ in crushed material is retained and delivered by chute on to conveyor No. 4 carrying the − 1½ in/ + $\frac{3}{16}$ in natural material to the secondary screen.

The − $\frac{3}{16}$ in crushed sand is washed through the screen by the spray water, flowing to the static settling cone already receiving the natural sand from the primary screen and is pumped with the natural sand to the sand drainage bins.

Blending.—Under each of the gravel storage and blending bins there is a Parker variable speed blender; and under the sand blending bin a Parker variable speed sand feeder. These all feed on to a horizontal conveyor, No. 5, in turn feeding on to an inclined conveyor, No. 6, which delivers the blended material, or single size material, to a lorry loading station for discharge direct to the lorries. Conveyor No. 5 is reversible to enable the company, if desired in the future, to add further storage for blended or single-size aggregates at the end of the plant.



The plant is landscaped to fit into locality; machinery is rubber lined to reduce noise; and the excavation will be backfilled as quickly as possible.

All blenders and the two conveyors are controlled from a panel in the ticket office. Any British Standard grading of material can be set up on the panel, and these can be changed from load to load by hand dials on the panel controlling the speed of the blenders.

At all times during the period of blending and loading, the specified percentage of ingredients is delivered to the lorry. Even the effect of the distance apart of the four blenders is allowed for by the timed sequence of starting.

Each individual blender is calibrated to deliver 2 cu. yd per minute.

It is possible, when two or more blenders are working together, by setting the blender delivering the largest percentage of the mix to maximum, and the other blenders proportionately, to obtain a greatly increased rate of loading. For example, 7 cu. yd of 1½ in ballast can be loaded in just over 2 minutes.

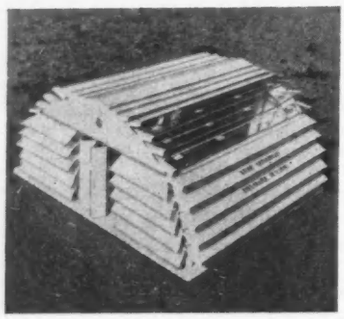
Single sizes can, if necessary be delivered direct from bins to lorry.

Greenham Sand and Ballast Company Limited, Chertsey Road, Feltham, Middlesex.

Inflatable Building with Venetian Blind Walls

The illustration shows a model of a one-unit Armadillo building. The load carrying framework consists of pressurized inflatable tubular members along which slide a series of flaps on the Venetian blind principle. The flaps run longitudinally and are connected to each other by a light steel cable which serves both as a spacer when assembling the unit prior to inflation and to operate the flaps to vary the degree of ventilation.

Any number of these unit buildings can be placed end to end to make up whatever length is required. Two end units are supplied with a



Model of a one-unit Armadillo.

one-unit Armadillo, usually one with a door and the other without, though both may have doors if required. Typical dimensions of a one-unit building are 10ft wide by 20 ft long, but these can be varied to suit customer requirements.

Advantages claimed for the Armadillo include: ease of construction and dismantling, no tools being required; it is lightweight and can be packed into containers for transport and delivery by parachute; it can be supplied with transparent or opaque sections; and it may be lined with either mosquito netting or insulating material.

Walter Kidde Company Limited, Belvue Road, Northolt, Middlesex.

Ground Freezing Aids Sewer Construction

In September, 1957, after heavy rains, the 3 ft diameter main outfall for Farnworth, Lancashire, collapsed and an overlying 15 in surface water sewer broken. The roadway gradually subsided to form a crater 120 ft long by 18 ft wide and 12 ft deep; 16 houses were shattered beyond repair, 99 houses were without sewage facilities, 121 houses had to be evacuated and 337 were made homeless. Downstream of the collapse, the main outfall was jammed for 175 yards.

Boreholes sunk in the area revealed a layer of silty material 20 ft thick overlaid by 15 ft of filling. It was concluded that collapse was mainly due to removal of support to the sewer by ground water movements at a point where the sewer crossed the Farnworth Hall Clough.

The consulting engineers, J. D. and D. M. Watson, decided that the new sewer should be built in tunnel on a parallel line, but 300 ft away from the collapse, and deep in the boulder clay underlying the silt. The new sewer is 6 ft 6 in in diameter and 800 yd long.

The level of the upper surface of the boulder clay is variable and, to ensure adequate cover above the tunnel, it was necessary to construct backdrop manholes with drops of 12 ft, 19 ft and 30 ft, the last being divided into two 15 ft drops. These relatively deep drops have been built with twin vertical cast iron pipes in the manholes, the sewage entering through spiral vortex chambers and discharging into a water cushion at the bottom.

The water-laden silt above the boulder clay, and the closeness of houses, made sinking of one of the shafts impossible either by free or compressed air, and the ground surrounding the shaft had to be frozen for 18 weeks before excavation and shaft lining could be taken down to the clay.

J. D. and D. M. Watson, 67 Tufton Street, Westminster, London SW1.

Plastic Dome for Observatory

The substitution of a reinforced plastic for an existing steel dome has been completed at Leyden University observatory in Holland. Construction in prefabricated sections, assembly on site, and positioning as one unit, are some of the advantages claimed for using glass fibre impregnated with resin. The design and fabrication of the dome was carried out by the plastics division of Werkspoor NV, Utrecht, using Setarol resins made by Kunstharsfabriek Synthese NW; the Setarol resins are distributed in the UK by F. W. Berk and Company Limited, 8 Baker Street, London W1.

The finished dome is 33 ft in diameter and, including the light steel framing, weighs under 5 tons. It was made by " hand lay-up " methods in 18 identical sections using only one mould. The site-made joints were filled with a patching

Erecting the dome for Leyden University.

compound formulated to cure at low temperatures.

Besides speeding up construction and erection, the use of glass fibre makes for light weight and reduces the load on the mechanism that rotates the dome. Good insulation and protection is given to the instruments in the observatory, the outer skin being impregnated with sun-reflecting aluminium and the inside being sprayed with asbestos fibres. Little maintenance will be required, for the structure cannot rust and is impervious to fungi and insects.

Norway's 1 Million MW Hydro-Electric Project

The first stage of Norway's largest hydro-electric project, Tokke I, has been completed after five years work. The station has an installed capacity of 100 MW and current is distributed at 300 kV, the first time such a transmission voltage has been used in the country.

In all, however, the scheme involves the construction of four more stations; together with that just opened, the gross capacity will be about 1 million MW. The total cost is expected to be around £50 million and completion is planned for 1965. The investment to date is £15½ million and the scheme is part financed by a $50 million loan from the World Bank.

The later stations of Tokke II, III, IV and V will have annual capacities of 920, 475, 175 and 70 million kWh respectively. In addition, a small 4 MW station has already been built for construction purposes and this will be kept in operation. In all, 30 dams will be built and more than 60 miles of tunnel driven; to date, 4½ million lb of dynamite has been used.

Rationalizing Structural Steel Production

Proposals are under consideration for a new British Standard which will reduce the number of sizes of steel beams rolled in the United Kingdom from 71 to 27. Such a rationalization should lead to greater economy in steel production, so improving the position of British manufacturers and fabricators seeking business overseas.

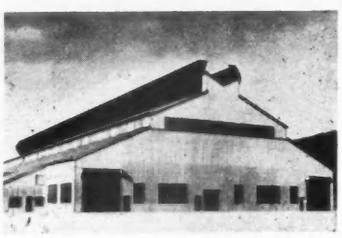
The proposal will permit the more frequent rolling of all sizes on the new list, resulting in speedier delivery and assisting in the standardization of designs, so simplifying drawing office work.

Since the introduction of universal beams in 1958, the number of I and H beams has risen to 71. Recently two more steelmakers have brought into operation universal beam mills and two other mills are planned. The British Constructional Steelwork Association hope that the new British Standard will be established by the end of this year and that the existing Standard covering dimensions and weights of available structural steel will be withdrawn on 1 January, 1963.

There is, of course, nothing to stop the steel manufacturers issuing lists of preferred sections for which speedy delivery can be ensured, so anticipating the recommendations and advantages of the revised Standard.

Roof Ventilation for Hot Works

Robertson Thain have introduced a new range of " Monitor " ventilators for installation along the ridge of factory roofs. The Monitor is designed for the " hot spots " of industry—glass furnaces, forge shops, heat treatment and die casting buildings—anywhere where fierce heat and fume conditions have to be handled quickly. It has been used for some years in the United States and Robertson Thain say that it is probably the only ventilator on the market capable of this



" Monitor " ventilator.

kind of duty. The version illustrated is 30 ft wide across the opening.

There are generally no moving parts to maintain and protected metal sheeting is used in fabricating the ventilators to promote a long service life. Monitors are available in any length and several sizes, each model being designed for a particular installation.

Robertson Thain Limited, Ellesmere Port, Wirral.

Compressible Bricks to Counter Settlement

The Council for Scientific and Industrial Research, South Africa, in collaboration with the Anglo-American Corporation, have developed a lightweight compressible brick for use as partition walls in mines where the rock ceiling is expected to descend over a period of time.

The bricks will allow ventilation and are designed for the stoping areas in mines. They are made from exfoliated vermiculite using a bitumen or plastic emulsion as a binder. Walls made of these bricks can allow for a drop in the roof of as much as 50 per cent of their height without collapsing.

Companies

Russians Take To Potato Crisps

After negotiations extending over a period of around ten months, ROBERT KELLIE AND SON LIMITED, Dundee, have been successful in obtaining a contract valued at £400,000 from Technopromimport in the USSR for the supply of complete equipment for the storage of potatoes and the manufacture and packaging of potato crisps, potato chips and potato cakes.

Robert Kellie manufacture food-processing machinery and are a wholly-owned subsidiary of VOKES GROUP LIMITED. This contract is the largest single order received by any unit in the Vokes group since the end of the Second World War. The firm found the Russian concern an exacting purchaser and credit for bringing the arduous negotiations to a favourable conclusion is due to the group's managing director, Mr. H. F. Osborne. He was assisted in his efforts in Moscow by Mr. A. J. F. McDonald, a director of Robert Kellie, and by Mr. A. Colman, the firm's technician.

Vokes Group's Good Order Book

When, in September last year, the company's name was changed to Vokes Group Limited, the trading activities of the concern were transferred to a new firm named VOKES LIMITED and, since then, Vokes Group Limited have been solely a holding company. The group's subsidiaries manufacture filtration apparatus, silencing equipment and specialized engineering products.

Their consolidated profit and loss account for the year ended 31 March, 1961, shows an increase in trading profits, to which all the subsidiaries contributed, but the chairman, Sir Ian Stewart-Richardson, Bt., is careful to point out that this profit is in no way due to improved profit margins. In fact, the tendency has been in the opposite direction, owing to difficulties in recovering increases in production costs within the firm's selling prices. These increases include a rise in wages which affected results during the period under review.

That the results were satisfactory was entirely brought about by increases in sales, in which connection, an all-time record was achieved both in volume and value; even with the exclusion of inter-company trading. Sufficient orders are in hand to ensure full production in all the group's subsidiaries for some months ahead.

As to the Common Market, the group have decided to proceed with their own arrangements and negotiations are well advanced for the acquisition of a substantial interest in a small engineering concern within the Common Market area.

Sir Ian expresses his regret that the proposals of the Chancellor of the Exchequer have again failed to include any direct incentive to firms to export their products.

He stresses the vital importance of the extensive research and development work being continuously carried out, not only in the group's filtration field, although this still covers the largest part of their production, but also in relation to the other diversified products manufactured by the various subsidiaries within the group. This work is the life blood of the group's future.

A Fight for Exports

It is the considered opinion of Mr. John Oldham, O.B.E., the chairman of OLDHAM AND SON LIMITED, Manchester, that the fight to maintain his firm's present export level, let alone increase it, is going to be a much more severe task.

The company manufacture storage batteries and safety lamps and equipment for miners. At present, no less than 25 per cent of their production is absorbed by direct exports. This satisfactory result is being attained against a background of intense and increasing competition, which the firm have encountered all over the world.

Another obstacle to their export business is the development of local manufacture, particularly in respect of automobile batteries. Mr. Oldham believes, however, that the increasing diversification of his firm's production will broaden the base of their sales in the export field.

There has, in fact, been encouraging progress over the whole range of the group's overseas companies. The South African subsidiary, for example, who were incorporated as a public company in 1949, have witnessed a steady growth each year. This concern were originally set up to manufacture the Oldham miners' electric safety lamp, of which there are now over a quarter of a million in daily use in the gold mines of the South African Republic and the copper mines of Northern Rhodesia.

At a later stage, the company enlarged their operations and extended their production into the manufacture of electric storage batteries for a variety of purposes, as represented by the commercial vehicle, electric traction and mechanical-handling equipment. The battery side of this subsidiary's operations now represents an important slice of their total production.

Young Men Above the Average

Management is the key to the future. Four years ago, Mr. Oldham referred to the time and effort which were being expended by his group in the training of young executives, in order to delegate work and increasing responsibility to them, so as to ensure that the company would everywhere remain alert, vital and youthful.

On that occasion, too, he referred to a training scheme which had been set up to provide a steady stream of above-average young men to be trained in the group's system of management.

Mr. Oldham now reports that the training scheme is proving of increasing value in providing young executives who can face up to the growing requirements of the organization which he has built up to its present level over the last few years.

He believes that Britain faces fierce competition in many markets. The road ahead is not going to be easy. It will demand a lot of hard work, common sense and cooperation at all levels if Britain is to maintain her position as a first-class trading nation. From the continued progress which his group have made so far, he has measured confidence in their ability to meet this challenge of the future.

Gaining Experience During the Vacation

It is now a well-established procedure for British firms to provide facilities for practical training at their works during inter-term vacations for college and university students. Engineering organizations play their full part in these schemes and many tens of thousands of students look back with pleasure and gratitude to the experience gained in this way.

Summer training is provided by many British engineering firms.

A somewhat out-of-the-run instance this summer is the engagement by JOHN LAING CONSTRUCTION LIMITED of 21 year old Miss Kik Hong Ong, of Ipoh, Malaya, as a student civil engineer on the building of the M6, the Birmingham-to-Preston motorway. Miss Ong, who is studying at London University, is spending her summer vacation on this work and is the first woman to be employed by Laing's in such a capacity.

Miss Ong was awarded a scholarship by the State of Perak last year and, on the completion of her training, will return to Malaya to fulfil a five-year contract which is one of the conditions under which her scholarship was granted. Her two brothers are also working for the company on the Birmingham-to-Preston motorway.

Nigerian Coal for Steelmaking?

SIMON-CARVES LIMITED, a member of the SIMON ENGINEERING GROUP, have been investigating the possibilities for smelting purposes of coal from Enugu in Nigeria.

The coal so far discovered there is of non-coking type, but, as a result of the firm's research and development work, a new method has been devised for producing, on a commercial scale, metallurgical fuel which it should be possible to use for smelting operations. This achievement is of special importance at the present time in view of an announcement by Dr. M. I. Okpara, the Prime Minister of Eastern Nigeria, that it is his Government's intention to construct a steelworks there which is likely to cost between £30 and £40 million, including modern equipment.

A full-scale demonstration, using this fuel, has been carried out at the coking plant of the SHELTON IRON AND STEEL COMPANY at Stoke-on-Trent, and gave successful results. Technically, this marks the first step in the setting up of a local steel industry based on Nigeria's own coal supplies.

Black and Decker's Improved Facilities

With a view to expanding their service facilities in the London region, BLACK AND DECKER LIMITED, makers of electric power tools, have opened a new service branch at 1 Brixton Road, London SW9.

To be known as the South London service branch, this depot will be the third in the area and is intended for the servicing of industrial power tools.

The other London branches, at Harmondsworth and at Holloway Road, will now be known, respectively, as the London West branch and the London North branch. Mr. W. C. May, previously branch service engineer at the London North branch, has been appointed branch service engineer at the South London service branch. He will be succeeded at the London North branch by Mr. W. Hickie.

New Subsidiary for Combustion Chemicals

Arrangements have now been completed by COMBUSTION CHEMICALS LIMITED, Dorset Square, London NW1, who specialize in the production of chemicals for the improvement of combustion efficiency, for the formation of a new subsidiary.

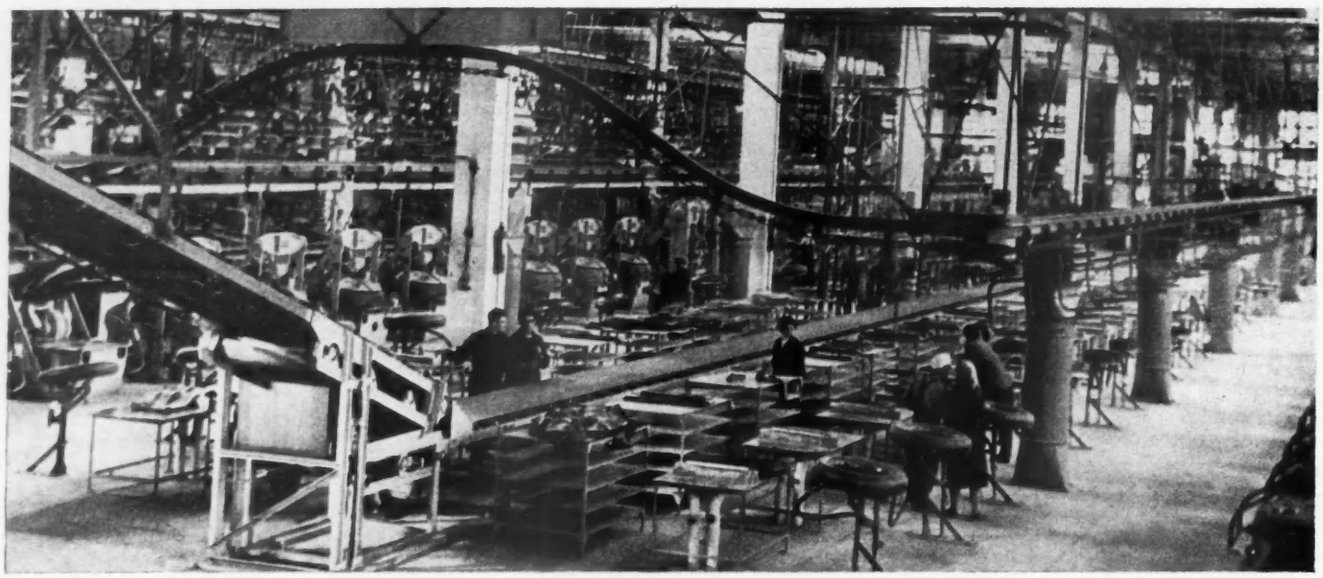
The new company is to be known as WATER ENGINEERING LIMITED and will engage in the manufacture in this country, under licence, of the range of water clarification and purification plant marketed on the Continent by the COMPAGNIE D'EPURATION ET DE TRAITEMENT DES EAUX, Paris, over the last few years.

At present, this range of equipment includes high-speed clarifying filters, a continuous purge type water purifier, and apparatus for water sterilization, demineralization and pretreatment. The principal unit is an instantaneous separator, known on the Continent as the "Danor," which is covered in this country by a patent. Many advantages are claimed for this equipment over the other types of hydro cyclones currently available in Britain.

Anticipating the Common Market

In order to speed up delivery times and to provide on-the-spot service facilities to their customers in Germany, and in anticipation of Britain's entry into the Common Market, BTR INDUSTRIES LIMITED (British Thermoplastics and Rubber Manufacturers), Vincent Square, London SW1, have now formed a wholly-owned subsidiary firm, with headquarters in Cologne, which will be known as BTR INDUSTRIES GMBH.

For the present, the new company will manufacture Hi-Flex hydraulic hose assemblies to British, American, German and French standards and sizes, principally for the iron and steel industry and for producers of agricultural, mining and hydraulic machinery.



Russians Look at Rubber Tyre Factory

A plant built in Russia by the British consortium of companies, Rustyfa, has now started pilot production of rubber tyres.

THE PHOTOGRAPHS reproduced on this page were taken by a Russian who visited the tyre factory put up by Rustyfa, the British consortium of engineering companies. They are taken from a recent issue of *Soviet Weekly*.

It is now reported that this factory has started pilot scale production of tyres in quantities of hundreds a month. Eventually it will be able to produce 2 million tyres and rubber tubes a year for the Volga, Chaika and Zil cars, for the Byelarus tractors, and for other heavy-duty vehicles. It has been recorded in *Rubber and Plastics Age* that it will eventually give employment to 2,500 people.

The Russian commentary in *Soviet Weekly* says: "The Dnepropetrovsk tyre factory will not have the biggest output capacity in the Soviet Union but it will surpass all others in output per head, and the working conditions are at a high level." It also says that workers at the factory are well pleased with the performance of the machinery in their first production runs.

Rustyfa was founded in 1957 for the purpose of supplying the plant and equipment for this factory which is situated in the Ukraine on a 79 acre site. The six member firms of Rustyfa are Crompton Parkinson, David Bridge, Francis Shaw, Lancashire Dynamo Holdings, Mather and Platt, and Simon Handling Engineering. Dunlop has acted throughout as the main consultants for the project through its subsidiary Dunlop Advisory Service.

The factory has been laid out and is equipped mainly to specifications recommended by Dunlop although they say that space has been left to accommodate Russian equipment. The Russians are known to have installed a number of their own presses already. Dunlop also provided a large number of foundation and other working drawings and the Russians undertook the construction of several of these.

This factory is similar in concept to the Dunlop Speke factory as all main production processes are carried out in a continuous flow on the ground floor. Some idea of this can be obtained from the above illustration showing the tube department.

Throughout there is a high degree of automation. For instance, the entire process of preparing and making the rubber mix is automatically controlled from a main control panel covering the four walls of a hall 170 ft long. There are pneumatic conveyors in the mill room and belt conveyors at most other stages. Altogether there are reported to be two miles of mechanical conveyors.

It appears that Rustyfa and Dunlop Advisory Service have done a good job in erecting this plant, which should augur well for the future. The present Russian seven-year plan is reputed to call for an increase in synthetic rubber manufacturing capacity from an estimated 440,000 tons in 1958 to about 1½ million tons by 1965 and considerable processing equipment will be required. Perhaps some of this will be of British origin. Rustyfa have, since the first order, signed a contract for the design and supply of a tyre factory capable of producing 1 million car tyres, 500,000 motor cycle tyres and 1½ million bicycle tyres a year for Rumania.

Illustrations on this page show: (Top) the conveyorized tube department; (bottom left) calender rolls; (bottom centre) the "particularly popular" lift trucks; (bottom right) the vulcanization section; and (immediately above) automatic tube vulcanizers.

Copper Foil Coated with Adhesive

Fothergill and Harvey are now offering a range of printed circuit grade electrodeposited copper foil coated with a dry thermosetting adhesive film. It is offered in three weights: one, two and three oz per sq. ft. For the first weight the adhesive is 1·4 to 1·6 mils thick (1 mil = 0·001 in) and the copper is 1·2 to 1·8 mils thick. For the heavier grades the adhesive remains the same thickness but the copper is approximately doubled and trebled in thickness.

These foils are intended for laminating into copper clad board for printed circuits. In tests with phenolic and epoxy laminates the following properties were revealed.

With XXXP phenolic paper: bond strength on static load test, 12-14 and 14-16 lb per in width; solder dip resistance, 15 to 30 secs at 260°C (using 1 in square floated on hot solder, copper side down).

With G-10 epoxy glass; bond strength on static load test, 12-14 and 14-16 lb per in width; solder dip resistance, 60 to 180 secs at 260°C (using 1 in square floated on hot solder, copper side down).

With epoxy paper: same as for G-10 epoxy glass as shown above.

Fothergill and Harvey Limited, Sladen Wood Mill, Littleborough, Lancs.

Non-Metals at Low Temperatures

Tensile strength and elastic modulus of reinforced plastics increase markedly as temperatures go down. Tests have been made at temperatures as low as − 423° F. At the 64th annual meeting of the ASTM this summer, M. Hanson, NASA Lewis Research Center in Cleveland, said that a major reason for interest in reinforced plastics for application at very low temperatures is that these materials are not notch-sensitive and cracks do not propagate as they do in metals. The ratio of the strength with and without a notch will be about 0·9 for reinforced plastics, he is reported as saying, and is much lower for most metals.

J. Hertz, Convair (Astronautics) Division of General Dynamics Corporation, described the use of non-metallic materials in both the Atlas and Centaur space vehicles. Reinforced plastic laminates are reported to be used for fairings, nose cones, and various housings. Freon-blown polyurethane foams are used for thermal insulation. High-temperature pressure-cured adhesives are also used in space vehicles. Certain plastics are used in conjunction with liquid oxygen fuel systems.

B. L. Taft, Pratt and Whitney, reported experiments to determine explosibility of various plastics under impact conditions in liquid oxygen. The test used is a somewhat crude go/no-go type. A weight is dropped on the specimen immersed in liquid oxygen with an energy of 70 ft-lb, and if the specimen explodes, it is not satisfactory for use in contact with liquid oxygen.

Several hundred materials are reported to have been tested by this process, including both metals and non-metals. The fluoro polymers such as Kel-F and Teflon have been found satisfactory, but the hydrocarbon types, epoxies and silicones are not.

ASTM, 1916 Race Street, Philadelphia 3, Pa., USA.

Panel Heater in Impregnated Asbestos

A heater panel moulded from Durestos—a resin impregnated asbestos moulding material—has been developed by Turner Brothers Asbestos. Incorporating an electrical heating element provided by Thomas French and Sons, these panels have excellent physical strength and will withstand a deal of maltreatment such as might be encountered in the home, Turners claim.

Durestos is preferably cured under heat and pressure in order to take full advantage of the material, but no-pressure moulded flat sections can be obtained. At 500 watts rating, a 2 ft by 2 ft panel will have a surface temperature of around 80 to 90°C.

Turners say they have put the panels through many tests including ones under water. The absence of breakdown or detectable current leakage leads them to think that the panels will be good for bathroom heaters or towel rails as well as the large variety of possible domestic applications.

Most of the popular contemporary finishes can be applied or they can be supplied pigmented. Turners say that stains or dirt can be washed off without detriment. Turners do not intend to market finished products but the information obtained from the development work is available to possible manufacturers. Those interested in end products will be introduced to moulders.

Turner Brothers Asbestos Company Limited, Rochdale.

Terylene Strengthened Conveyor Belting

This illustration shows Terylene reinforced conveyor belting, made by the Leyland and Birmingham Rubber Company, in use at Bickershaw Colliery in Lancashire. The National Coal Board is reported by ICI to have now placed substantial contracts for this belting.

The particular location at Bickershaw Colliery is a gate conveyor in a section of the pit where rock falls and shifting of the conveyor alignment due to old workings are common. Despite this, substantially the same belt has been running for over 12 months.

Terylene reinforced belts are now used in

widely varied conditions, from 14 ply 2 metre wide belting capable of transmitting 2,000 hp, used in the USSR for conveying iron and non-ferrous ores, to belting for conveying gravel, where 3 or 4 ply construction used is cheaper and stronger than 100 per cent cotton, say ICI, makers of the Terylene polyester fibre.

Imperial Chemical Industries Limited, Millbank, London SW1.

Carryover of Steam Impurities

As pressures and temperatures in boilers in steam power systems steadily increase, vaporous carryover of salts in the steam takes on increasing importance. A research project to investigate the mechanism of vaporous carryover conducted under the sponsorship of ASTM committee D-19 on industrial water with the aid of a grant from the ASTM research fund has just been completed.

A report on this project was presented by M. M. Rubright of the Babcock and Wilcox Company at the ASTM 64th annual meeting held this summer in America.

Studies conducted in a small test boiler at a pressure of 2,500 lb per sq. in gave results indicating stoichiometric vaporous carryover of sodium chloride at low steaming rates (2 and 5 lb her hr). Some preliminary investigations at a pressure of 3,000 lb per sq. in failed, however, to show clear-cut evidence of a stoichiometric ratio in the vaporous carryover.

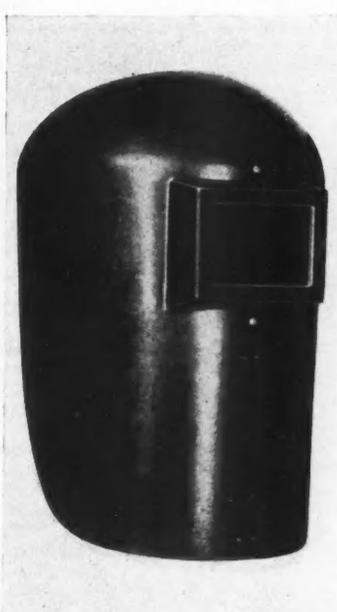
A research programme to determine the extent of vaporous carryover of sodium salts in large, high-pressure (2,500 to 2,600 lb per sq. in) boilers having full-load steaming rates from 1,200,000 to 1,600,000 lb per hr and in operation by public utility companies was described by R. C. Ulmer and H. A. Klein of Combustion Engineering, Inc. An attempt was made to determine the agreement between volatility effects predicted by laboratory investigators and those observed under field conditions. Conditions of boiler operation and of sampling were carefully controlled. Sodium chloride concentration in the boilers was maintained at 10 to 25 ppm. Results appear to show, it is reported, that vaporous carryover of sodium salts from boilers operating at 2,600 lb per sq. in or less should not present a serious problem so long as the salt concentration in the boiler water is maintained within reasonable limits.

ASTM, 1916 Race Street, Philadelphia 3, Pa., USA.

Towards Mass Production in Reinforced Plastics

About two years ago Leicester, Lovell started making a pre-impregnated plastic material which they called Resnit. A use has now been established for it by William Stephens and Sons who use it for the model of welding mask shown here.

Resnit consists of a knitted cotton fibre and a phenolic resin. It is supplied in the form of dry, semi-rigid sheets up to 48 in wide. To form this material into shapes it is pressed in a heated tool. The availability of such material has been held to herald the day when plastics can be pressed into complex shapes like metal pressings. The one shortcoming which is generally



held against such material is that a cure time of anything up to 2 minutes at 150°C is needed before the dies can be opened.

For making welding masks, William Stephens say that they previously used paper pulp and vulcanized fibre. Very briefly, they list the following advantages of Resnit over these materials: reduction of the weight factor by 33 per cent or more; mechanical strength; absolute imperviousness to moisture; complete insulation both electrical and thermal; cleanliness of line and subsequent speeding up of production.

Leicester, Lovell and Company Limited, North Baddesley, Southampton.

William Stephens and Sons Limited, Crawley Road, Wood Green, London N22.

Containers for Cheaper, Easier Handling

Significant economies in overall manufacturing costs can often be made through savings in packing, handling, transport and storage costs. This unit-load container system of bulk materials handling has often effected such savings, particularly for transport by rail.

THE Tote bulk-materials handling system which has been used extensively by many industries in the USA has been introduced to Europe by Pressoturn Limited. It represents a real step forward in materials handling, for it offers the advantages of light, strong and easily handled containers which can be utilized for weather-proof storage in the open. There are four sizes of unit load, the three smaller ones being particularly well suited to rail traffic and, indeed, British Railways have already cooperated in giving special freight rates to materials carried in these unit loads. Fig. 1 shows Tote bins loaded on railway wagons.

Components for the system are carrying bins, discharging tilts and ancillary equipment for controlling the filling and discharge operations. Bins are available in four standard sizes with carrying capacities of 42, 74, 95 and 110 cu. ft, the first three sizes being small enough for two bins to be loaded side by side in a railway goods wagon though the largest size is outside the British Railways inter-regional loading gauge. The bins are strongly constructed of a high-strength, fully heat-treated aluminium alloy (HS 20); the top and bottom are pressings welded to the body which is formed from two sheets wrapped round and joined with two vertical welds.

INTEGRATION WITH PRODUCTION

Tare weights for the different sizes are 165 lb (75 kg), 225 lb (102 kg), 256 lb (116 kg) and 285 lb (130 kg). The carrying capacity of the bins is more likely to be governed by volume than by weight but, in the case of materials of high density, loads of up to 6,000 lb (2,723 kg) can be carried, giving a useful tare/weight ratio.

The bins stand on four legs, providing a clearance of 1½ in (38 mm) at the front and 4½ in (114 mm) at the sides and back so that they can be handled by fork and pallet-lift trucks as shown in Fig. 2. There are also four corner pads on the bin top to give extra strength and protection and to locate the legs of an upper bin if double stacking is used.

Loading is effected through a 9 in diameter aperture which is fitted with a lid that can be hermetically sealed if required. The method of filling varies with the type of material to be carried, but for most granular products the only equipment necessary is a simple spout and the operation can often be completed without removing the bin from the wagon in which it is to be transported. If the material does not flow easily, or has an acute angle of repose, the bin is sometimes placed on a jolter and a spinner lowered into the bin to obtain the maximum fill.

Discharging contents of a solid nature is usually automatic with the aid of a tilt and, except in special circumstances such as discharging into a tank above ground level, a normal fork or pallet truck gives sufficient lift. After the bin has been located on the tilt it is tipped to an angle of about 45° and the discharge door is opened with a key. A tilt vibrator might be used if the material is one which does not flow easily. As the door opens the contents then flow, without the possibility of contamination or creation of dust, on to, for example, a screw conveyor connected to hoppers, bins or handling equipment.

Thus, the Tote unit load carriers can fit in directly with the production processes in many types of manufacture. Where it is necessary to blend materials in varying proportions, this can be done by using variable speed drive for the screw conveyors fed from two or more tilts. In one existing application five different materials are discharged by weight into a blender, the five tilts being mounted on separate weighing platforms which have scales pre-set to the required amounts. Each bin discharges into a common conveyor system, discharge stopping automatically when the correct amount has been fed.

From this description of the bins and the method of operating them, it is clear that they are a type of packing or container particularly appropriate for bulk transport of raw materials or work in progress. They have distinct advantages over more conventional types of pack from the aspects of integration with production, general handling, storage and transport.

Their usefulness as a method of packing which can be integrated with production needs in processing and similar industries lies in the ease with which they can be filled and discharged directly from and to normal production handling equipment. They can also be adapted quite easily to serve more sophisticated processes, such as the blending operations mentioned above, in a less wasteful and more dust free way than is possible with older and often higher-cost types of hopper feed.

For handling in general, the system has the advantages of speed and controlled discharge, and it does not require special handling equipment. For storage, it has further advantages including simple selection and lifting of stock; low insurance rates; adaptability for long or short term storage as, for example, between production and packing departments; and complete protection from the weather with the minimum of capital expenditure. On this last point, there have been a number of cases where manufacturers have been able to use the bins as a form of covered storage on ground which is unsuitable for building. In warehouses, compactly packed Tote bins have often saved up to 15 per cent of the storage space normally required for bulk materials, even without stacking. Where there have previously been limitations on storage space, this has sometimes enabled firms to obtain bulk discount rates by placing bigger individual orders.

As a transportation medium, the system has further advantages, namely, diminished recurring packaging costs; low return carriage costs; economic loading of vehicles because of the unit size of the container; strength, lightness and ease of handling; low cleaning and preparation costs; hygiene; and elimination of any material loss.

HIRE SYSTEM

The Tote bin method of transportation and handling thus has many advantages from the carrier's point of view, as well as the manufacturer's, and British Railways have been quick to appreciate them. As a standard open wagon will hold eight bins, a good pay load can be carried on standard rolling stock and loading and discharge times are greatly improved. Further, when dealing with materials of a dangerous or obnoxious nature there is no risk to staff or contamination of rolling stock.

Tote bins have quickly proved their usefulness for rail transportation. For example, after a pilot scheme with 50 bins, each of 95 cu. ft capacity, was introduced to carry carbon black from Avonmouth to Fort Dunlop its immediate success was such that the order was increased to 500. Other uses to which the bins are now put are the carriage of pitch from Manchester to Newcastle, china clay from Cornwall to Manchester, and pigments between Grimsby and Slough.

British Railways hire out these bins and charge carriage on the net weight only. Special freight rates include free return and sole use is guaranteed—and advertising on the bin permitted—when bins are hired on an annual basis.

There is evidence to support the manufacturer's claim that the Tote system will pay for itself in a matter of months. One case in point is the experience of a plastics firm, handling 446 tons of powder per month, which made an overall yearly saving of £36,430 for an outlay on Tote equipment of £28,690. There have been even greater savings in the handling of salt.

Among other materials now being handled by the system are activated carbon, china clay, cornflower, glass batch, lacquer, pitch granules, plastic powders, slate dust and sugar. Most such materials can be handled with the basic design of Tote bin but the manufacturer can vary this design for special applications.

Pressoturn Limited, Leamington Spa, Warwickshire.

Fig. 1 (Left) Open railway wagons loaded with Tote bins.

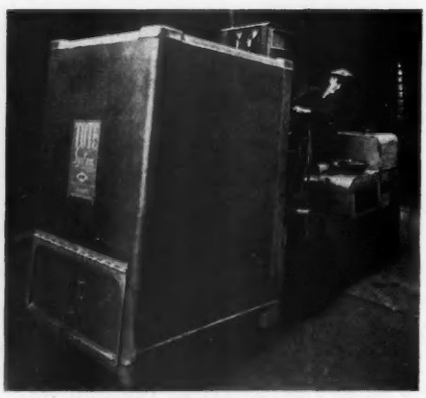


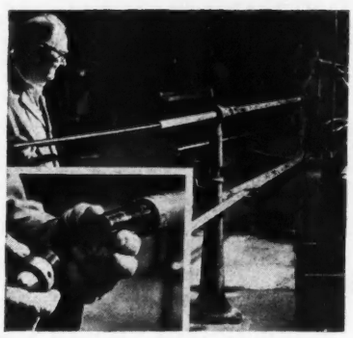
Fig. 2 (Right) Fork lift trucks can be used to multi-stack Tote bins.

Nylon Stock Tubing Quieter

A principal source of noise in automatic lathes is the movement of the stock bar within the stock tube and a common way of endeavouring to reduce this noise level has been to use a coiled spring type "silent" tube. Now this noise absorption has been carried a step further by the introduction of an extruded nylon tube inserted within the existing stock tube.

This method has been tried by Shove and Company, of Enfield, who have fitted plastic tubing inside stock tubes handling square and hexagonal section bars on about 40 machines. Complaints about noise which used to be made regularly by local inhabitants have now ceased and conversation has become possible in the workshop.

Besides noise reduction, nylon stock tubing



The nylon silent stock tube is easily fitted within the stock tube of an automatic lathe.

is a comparatively cheap type of silencing agent, and it also eliminates the possibility of damage to the surface of the stock bars. Further, the wear resistant properties of nylon stock tubing compare favourably with other types. An example quoted by the manufacturers is that of a nylon tube of ½ in nominal inside diameter which was measured after the equivalent of one year's single shift working on hexagonal bar, 7/32 in across flats at 6,000 revolutions per minute: the only appreciable wear was 0·05 in at a distace of 2 in from the end, while in the centre there was virtually no wear at all.
Uni-Tubes Limited, 50 Oxgate Lane, London NW2.

Transfer Line for Sawmills

Woodworking machinery manufacturers are now developing methods of linking sawmill plant and the first successful yard bogie/cross-cut saw/moulder transfer line to be controlled by a single operator has now been designed and installed. This line, for the continuous production of cross-cut and moulded stock from random-length unplaned timbers, represents a significant breakthrough in the field of primary timber preparation.

The equipment includes an entirely new design of tilting and travelling unloader hoist, and unconventional mechanized tables for the cross-cut which permit the use of automatic feed and take-off devices. An output equal to that of three conventional cross-cut saws feeding a moulder is possible with this transfer line while using much less labour. It consists of an unloader hoist and hydraulic cross-cut saw with mechanized tables and remotely controlled stops, together with the necessary equipment for connecting the hoist at the in-feed end with the moulder at the out-feed end.

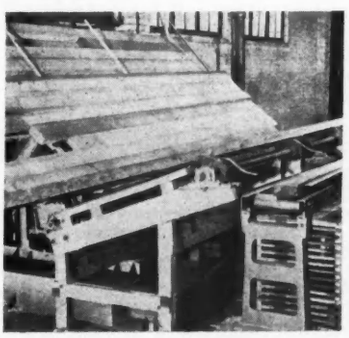
In addition to the normal tilt and rise and fall movements, the hoist has a horizontal traverse of about 6 ft, thus combining the advantages of a conventional unloader hoist with a fork-lift platform. It is able to lift a standard timber sett from a truck, stillage or floor chains in the yard, and then take the load into the mill before discharging it layer by layer on to a side delivery conveyor which spaces the timber lengths and delivers them individually to the cross-cut in-feed table. The cross-cut operator controls the side delivery conveyor by a single hand lever which also actuates linked side pressure arms on the in-feed cross-cut table to control the lengths during the cut.

Foot controlled, power-driven rollers on the cross-cut in-feed table facilitate the quick handling of the lengths in either direction. An up-to-date hydraulic straight-line saw is used and up to sixteen one-foot adjustable stops are provided for length gauging. A trim stop squares off the ends of the timber and hydraulic kickers push the cut piece clear of the stop tongues as the saw completes its cutting stroke, so that it is free to move along the cross-cut outfeed conveyor belt.

The cut pieces are then automatically fed into a moulder by way of constantly running belt conveyors and rollers, the latter acting in conjunction with the conveyor to force the pieces into the machine's feed rollers. The length of the conveyors and their speeds are designed to keep the moulder fed continuously, though the cross-cutting operation is intermittent.

The controls for the cross-cut saw, length gauging stops, conveyors and tilting hoist are grouped within the operator's reach at the front of the cross-cut saw. Without assistance, he is able to control the unloading of the truck, and the delivery of timber to the cross-cut saw, where he can inspect and cut to selected lengths, ultimately feeding the cut pieces into the moulder by the conveyor system.

The transfer equipment makes for high machine



A timber sett on the tilt hoist being discharged on to the cross-cut infeed table by way of the side conveyor.

utilization and eliminates the production bottlenecks which are common with conventional machines. Manual handling is almost completely eliminated and operator fatigue—and therefore accident proneness—are greatly reduced.

This plant points the way to future trends in timber processing plant layout and transfer equipment for continuous flow production.
Thomas Robinson and Son Limited, Rochdale, England.

Thermic Boring Cut These Costs

Melting a hole through 7 ft thick concrete 40 ft below ground level has saved a costly and long reconstruction job at Ffestiniog power station, in North Wales. The turbine house extends more than 100 feet below ground and is constructed of reinforced concrete. During construction it became necessary to re-route the drainage system, a process which involved making a hole through the 7 ft wall.

Using the thermic boring technique, a 9 in diameter hole was bored through the wall at an angle of 15° to the horizontal in only 24 minutes.

This technique involves heating the tip of a lance made of gas piping, packed with small steel rods, until it is red-hot. Oxygen is then blown through the lance, heating is stopped, and the reaction of iron oxidation at the end of the lance is maintained solely by the oxygen. The reaction generates sufficient heat to melt even concrete. Using light, inexpensive and easily handled equipment, the technique is at least twice as fast as mechanical drilling and is practically noiseless.
The British Oxygen Company Limited, Bridgewater House, St. James's, London SW1.

Computer Control for Steel Furnace

A computer system is to be installed for the National Steel Corporation, USA, to control the world's biggest basic oxygen steel furnace plant in Detroit.

It will determine the amount of raw materials required and prescribe the amounts and types of additives necessary to produce a given quantity of finished ingots of stipulated specifications. The heat generated in the furnace will be controlled by adjustments to the flow rate and duration of the oxygen blow. This will ensure consistency and high quality of product.

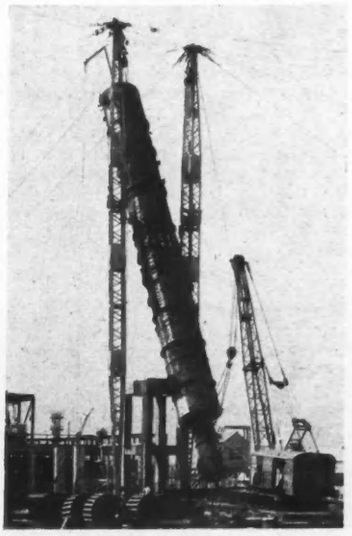
The installation is being made by Thomson Ramo Wooldridge, of Los Angeles, USA, who share with GEC Limited an interest in International Systems Control, of Wembley, Middlesex. Details of the system will shortly be available for applications by the latter company.
The General Electric Company Limited, Magnet House, Kingsway, London, WC2.

54 Ton Fractionating Column

A steel fractionating column weighing 54 tons has been made by G. A. Harvey to the design and order of the Kellogg International Corporation for the Mobil Oil refinery at Coryton. The column, which was completed on schedule, has a main shell 109 ft long and 10 ft in diameter.

It is made of mild steel plate ¾ in thick and has at each end a dished and flanged head, spun and formed on Harvey's rotarpress. After manufacture the column was hydraulic pressure tested up to 110 lb per sq. in.

This is the longest fractionating column fabricated by Harvey's in the past 18 months and will be used for the processing of crude oil.
G. A. Harvey and Company (London) Limited, Greenwich Metal Works, London SE7.



The fractionating column being raised at Coryton.

On the Shelf

By Frank H. Smith

MANY of us have experienced the American technique for saving paper, time, filing space and what-have-you by simply chalking a monosyllabic reply (Out of Print, No Dice, etc.) on the sender's letter and either sending it back *tout seul* or with a printed pamphlet explaining the position. This goes a stage further when they themselves want something. Monsanto Chemicals, for instance, send an envelope which, when the flap is pulled out, reveals a standard message asking for a reprint. If you cannot play you simply put a cross (or tick) in the space provided. The whole envelope has a reply-paid cover to use either for the material you send or for the expression of inability to provide. Damned clever these Chinese—sorry, Americans. Oh, for the good old days of those letter books that had to be damped and then shoved in a press by the office-boy!

I was a bit confused to find that *NRC Library Bibiliographical Series* No. 1, "Bibliography on fuel cells," by T. D. Wilson, does not come from the National Research Council (of Canada) but from C. A. Parsons and Company Limited, Nuclear Research Centre, Fossway, Newcastle upon Tyne 6. All credit to Mr. Wilson for his 232 references, but I think Parsons should do something about those initials.

Robert Franklin, the librarian of Toledo Public Libraries (whom I have mentioned before and who suspects me of anti-American activity) made a rather pleasant gesture in sending to Alan B. Shepard (spaceman 3) two volumes of a rare aeronautical book (Tissandier's *Histoire des Ballons*) and in his letter of acknowledgment, Shepard apologizes for delay because "I have been extremely busy for the past few weeks." A nice touch, worthy of an Englishman.

Transactions of the ASME Series B (*Journal of Engineering for Industry*) for August is given over to "Ten Years Progress in Management, 1950–1960." It is rather frightening that ASME should manage to collect 20 large papers on this subject and one wonders if the time will come when everybody will be an executive. Where will the electrician's mate for the "Mermaid" come from then?

Racal Engineering Limited and Racal Instruments Limited, of Bracknell, Berks., send No. 1 of *Racal Review*, their new "house journal." I've put it in quotes because that is what they call it but, at the moment at any rate, it is only four pages and is all Racal. I look forward to this acorn growing a bit into an oak with a few more leaves.

You can get the complete 1961 Cleaver-Hume Press catalogue from 11 Wright's Lane, Kensington, London W8. All their forthcomings are listed on one page. Cambridge University Press (200 Euston Road, London NW1) have also brought out their July–December list and this includes new titles in their paperback series.

Some time ago I mentioned the forthcoming *Electronics and Communications Abstracts* (Multi-Science Publishing Company, 33 South Drive, Brentwood, Essex). Publication starts in September and specimen pages and rates are available.

I cannot say that I get a lot from the Science Museum Library *Lists of Accessions to the Library* in the way of likely material for my library but I do get a kick out of reading those items that always start each weekly list—to wit, the bibliographies. Week ending 3 June, for instance, a Mr. David Eric Symon has compiled "A bibliography of subterranean clover, together with a descriptive introduction." Now who on earth writes about subterranean clover? Symon has managed to whip up 126 pages. Do pit ponies eat the stuff? Do subterranean bees make subterranean honey? Paul Jennings should hear of this.

Pumps for the User

Centrifugal Pumps: Selection, Operation and Maintenance. By IGOR J. KARASSIK and ROY CARTER. *F. W. Dodge Corporation, New York; Interscience Publishers, London.* (£5 19*s*)

The book, as explained in the foreword, is for the practical engineer and pump user. The authors feel that the theoretical aspects have already been adequately covered elsewhere, so they concentrate on the practical parts of pump engineering.

The whole field of centrifugal pumps is covered, as well as mixed flow and axial machines where relevent. The structural parts and details of pumps are fully described and illustrated both with photographs and drawings. Such parts as impellers, volute casings, seals, bearings and hydraulic balancing devices are mentioned, in addition to chapters on vertical, multistage, self-priming and chemical pumps. The sections on condensate and boiler feed pumps are particularly comprehensive. System layout and its effect on the pump are dealt with together with the estimation of friction and other losses.

In discussing pump performance and without delving too deeply into theoretical discussions, the terms and symbols used are adequately described. Typical characteristics are given for various types of pump, and a method of determining probable performance from bolt sizes and pump dimensions is indeed ingenious! The effects of pump speed and diameter on performance are considered as well as those of change of density and viscosity.

Further sections deal with electric motors, pump drives, and methods of controlling and priming pumps. The installation needs are outlined, while some valuable suggestions are made on information to be included in pump tenders.

Charts are included for the conversion of units, efficiencies of different pumps and suction head requirements to prevent cavitation.

Style and layout are good, and little knowledge of pumps is required to understand the book. The authors aimed to produce a comprehensive book for the pump user and in this they have ably succeeded. At the same time it is felt that a lot of the very elementary matter could be omitted, to cheapen the book for a wider market. For instance, do we need to be told that flow can be measured in "million gallons per day, cubic feet per second, gallons per hour," etc? A bibliography would be helpful too for those seeking further information.

Nevertheless, it is a useful book for the plant engineer and pump user.

I. S. PEARSALL

Doing it the Right Way

The Skills of Interviewing. By ELIZABETH SIDNEY and MARGARET BROWN. *Tavistock Publications.* (35*s*)

The Manager and the Organization. By ERIC MOONMAN. *Tavistock Publications.* (21*s*)

Efficiency and Effort: An Analysis of Industrial Administration. By W. BALDAMUS. *Tavistock Publications.* (18*s*)

To pick up a book and read it presents few problems. To read three in a row, however, requires some management. There are decisions to make. Which one first? and why? Here the choice was made on size alone: get through *The Skills of Interviewing* first and over half the reading would be done. It didn't turn out quite like that. By the time the job had come to a sticky stop in Mr. Baldamus's bog there was obviously more in it than the mere passage of pages. In a moment of unannounced lucidity Mr. B does throw some light on why workers, given the choice, perform their tasks in a certain sequence. The workers usually have the advantage, however, of knowing what is coming.

The passage through the books of the two ladies and Mr. Moonman, in that order, was relatively calm. Interviewing is described in its broadest sense, as involving any two (or more) people meeting face to face, for any specifiable purpose, and conversing. As this happens often to all of us it is easy to be identified personally with much that is written. The interviewer gets rather more attention than the interviewee and, as the senior member, is given the greater responsibility for the success or failure of the interview.

Those who have suffered in bad selection interviews will wish their tormentors might read this book. At the same time they should be prompted to search their own souls in finding what went wrong. It is clear that any interview is in danger unless adequately prepared by both sides. Interviewing is thus no different from any other management technique in its need for a methodical approach. The authors' development of this theme tends to become a little depressing. For successful interviewing, the clarity of objectives and the supporting knowledge and information are required to be of an order higher than many management situations have it in them to achieve. The quality of management will not be better than appears in the quality of interviewing. Until the elementary needs of effective talking and listening are observed the remainder of management activity will find little joy.

Mesdames Sidney and Brown are readable. They take a bit of a risk, however, by plunging early into the relatively abstract matter of "The Development of Personality." The neediest readers would be safer on more concrete paths until deeper into the subject. The readers' interest may also flag during long verbatim reports of interviews conducted in training situations which have not quite the sting of real life.

Proof-reading could have been better. A book so close to the heart of management should quote Urwick's initials correctly.

What is expected to follow a title like *The Manager and the Organization*? Mr. Moonman has room only for a dip into this vast pool. Whether it is a lucky dip depends on what the reader expects for his money. It is not clear why the book is divided into two parts—"The Manager" and "The Organization." Part I is almost wholly involved with communication under its own name and part II with communication under other names. The title is not a good example of communicating to a prospective reader the specific nature of the book.

Communication topics are the meat between rather thin slices of management and organization. When the author does call management and organization by their first names he is seen to be fairly well on the beam. Not spectacular, but sound enough. Unfortunately, he swings rather violently between short spells of basic philosophy and lengthy descriptions of specific practice. What, for instance, is a chapter on Quicker Reading doing as a sub-heading of "Style and Simplicity in Expression"? A passage like:—

> "The results of a survey undertaken at . . . show that following quick reading courses an increase in product output of about one-third may be permanently achieved, if the extra output is rewarded and working conditions and the flow of work improved."

suggests sheer confusion between causes and effects. This is hardly consistent with the authority needed to make the closing chapter "Management and the use of the Systematic Method" convincing. This book is for the young and the uncritical.

One cannot disagree with Mr. Moonman

over the need for style and simplicity in expression, and quicker reading is useful so long as it does not increase exposure to and absorption of poppycock. If plain words, simple style and short sentences give clarity of understanding Mr. Baldamus must be incomprehensible. Quicker reading of his introduction would cause in most readers a screech of mental brakes to an emergency stop. Much of this stuff defies comprehension at any speed. 74 words without a full stop, 39 of them without even a comma, can be described as a bit thick.

The spate of jargon suggests that Mr. Baldamus is not just a sociologist, but a sociologist's sociologist—which puts him beyond the ken of the plain man. The trouble is that those who are really in the position to extract results from workpeople by applying new knowledge on efficiency and effort are usually very plain men indeed. Their suspicions of people like sociologists will only be confirmed by this kind of writing.

It is all the more annoying because there are, within the book, articulate flashes when real depth of meaning comes over with great impact. The three chapters under the heading of Industrial Motivation reveal fascinating interplay between the pairs of factors: Impairment and Inurement; Tedium and Traction; Weariness and Contentment. Why cannot it all be like that? Perhaps because for a while the scene, as in interviewing, becomes identifiable with one's own experience. Credibility tends generally to be bedevilled by humble concession of the unsolvable nature of the problems under discussion, and by analyses which yield more confusion than clarity.

If anyone wonders what kind of person reads books on sociology, the answer is clear: Sociologists. These books are heavily laden with references which show that all the authors have read more or less the same stuff and have used much of it to write more. A large bibliography is all very well if handled unobtrusively. Mr. Baldamus' use of references adds an element of distraction to an already over-difficult task.

F. W. LATHAM

Foundation Experience

Foundations. By A. L. LITTLE. *Edward Arnold.* (100*s*)

Foundation Failures. By C. SZÉCHY. *Concrete Publications Limited.* (20*s*)

It is not easy for an engineer to become proficient in the design of foundations. The time-scale of civil engineering work is such that first-hand experience accumulates but slowly. Full-scale tests to destruction are so rare, for economic reasons, that the true strength of a foundation is only discovered if it happens to be less than the applied load. Excessive settlement may not become apparent until a structure has been standing for a generation.

Despite increasing assistance from the science of soil mechanics, the subject is still largely empirical, and the science itself has developed so recently that many engineers must have found how difficult it is to teach oneself.

Fortunately, the recorded experience of others is of lasting value in this branch of engineering. *Foundations*, by A. L. Little, is both a record of foundation experience and a textbook of soil mechanics and foundation design methods. It is written in a lively style and should prove of value to both the professional engineer and the civil engineering student.

The principles and methods of soil mechanics are clearly set out, and examples of almost every known type of foundation are described, and profusely illustrated by 290 photographs and diagrams. In most cases a summary is given of the information obtained from the site exploration, the design assumptions made, the method of construction adopted, and, most interesting of all, the unexpected difficulties encountered on the site, and the remedial action taken.

Throughout the book, care has been taken to mention sources of information, and the list of about 500 references is used extensively to refer the reader to fuller treatment of a subject.

It is a matter for regret that the author has interpreted his title so narrowly as to exclude all reference to active and passive pressures and to retaining walls. There are several interesting descriptions of cofferdam construction, but only one of these contains useful information about the lateral pressures designed for and experienced.

The index is good, and the diagrams both detailed and clear, but the contents page could be improved. It gives only the six chapter headings, and some chapters are nearly 100 pages long.

The author is particularly careful to emphasise the pitfalls of foundation design and construction, and case records of failures appear throughout the book. His attitude towards empirical formulae is well expressed by the quotation from Mohr, who said of the Hiley pile-driving formula, "Its only obvious advantage . . . is the great number of unknowns to which a series of values may be applied until an answer satisfactory to the interested party is finally reached."

There are occasional references to the troubles of engineers of past ages, and quotations from Roman and other historians. This, together with the high quality of the paper and illustrations, makes this book most readable.

Dr. Széchy's book *Foundation Failures* is in the well-known style of the Concrete Publications series. The author is Professor of Foundation Engineering at Budapest, and the majority of failures he describes are likely to be unknown to English-speaking readers.

The causes of failure are classified into four groups; inadequate or wrongly interpreted site investigation, faulty design of foundation or superstructure, defective temporary works or workmanship, and insufficient provision for exceptional natural phenomena.

Explanations of the failures are accompanied by approximate calculations and details of the remedial measures taken. The author assumes a knowledge of soil mechanics, and covers a wide range of foundation types.

R. P. JOHNSON

Transformers Meet New Demands

The J. & P. Transformer Book. By S. AUSTEN STIGNANT and H. MORGAN LACEY. 9th Edition. *Johnson and Phillips Limited, Charlton, London SE7.* (70*s*)

It is probably true to say that since the last edition of the *J. & P. Transformer Book* was issued in 1941 there has been greater development in transformer design than in any corresponding period in its history.

The doubling of system maximum demand every eight to ten years almost certainly enforces an increase in system voltage at intervals of approximately twice this period. In this country, for instance, system voltages have risen from 132 kV in the late twenties, through 275 kV in 1950 to 400 kV in 1961. Since voltage rather than current presents the greater problem, a prospective change in voltage usually is preceded by a period of research activity and a reappraisal of existing design techniques; one has only to note the many high voltage research projects in various countries to be satisfied that this is so.

The more effective use of existing materials and the application of new ones are ever present preoccupations of the designer. Moreover, increases in system voltage are invariably accompanied by a demand for units of larger rating and this need to use materials effectively is emphasised by the problems that are arising with increasing frequency over the matter of transport: even so, the time is not far distant when the limit for the maximum indivisible load will be reached and new thinking will be required from the designer on the development of transformer designs which will permit of "piece-small" transportation with site reassembly and all that is thereby entailed.

The development of grain-oriented cold reduced steel, first introduced in the USA and within the last decade into this country, temporarily eased this pressure on weight limitation but it has produced a series of new queries on its application to transformer cores. Fluxing this new material across the grain materially increases the watts loss and from this characteristic has stemmed new ideas on core interleaving and construction and a move away from core bolts towards core banding. In parallel with this development has been the introduction, for smaller ratings, of the strip wound type of core bonded with epoxy resin.

Grain-oriented steel can be worked to higher flux densities than hot rolled material but as this may be accompanied by an increase in noise, the question of noise is now receiving more consideration than hitherto. A further reason for this is that transformers, more and more frequently, are having to be installed in suburban districts; the need to avoid complaint has resulted in limitations being set on noise and amelioratory measures being developed.

No review of recent development would be complete without reference to the effect on transformer design of transient overvoltages. The distribution of surge voltage throughout a winding is now well understood and several interesting winding designs have been developed as a consequence. Competing with each other are the shielded disc winding, the layer type and the interleaved type winding: each has its merits and all are in service.

To prove designs, impulse tests have been devised and are still being refined.

One further matter of current interest is the performance of a transformer under short circuit. With the expansion of overhead systems, the probability of short circuits occurring is increasing and users wish now to be assured that a transformer is capable of withstanding short circuits and still remain serviceable.

These then are some of the developments that have taken place over the last decade or so, and no textbook that purports to reflect modern thought on transformer design could neglect to discuss some at least of them.

With the vast amount of material available, difficulties in selection are very real. That the authors of the *J. & P. Transformer Book* have been so successful in this regard is no doubt due to their experience with previous editions and their deep knowledge of the subject.

The extent of the revision has caused the authors to completely rewrite their book, but to assist those already familiar with earlier editions they wisely have indicated in a preface to the new edition the changes that have been made

and the chapters directly affected. The book now comprises 892 pages made up of 29 chapters and ten appendices with numerous photographs and illustrations. Naturally, such matters as fundamental transformer principles and the basic forms of transformer construction and the like are retained and appear alongside the new material which has obviously been carefully selected so as to provide an introduction, at least, to most of the developments over recent years. In a book of such a composite nature as this it is not difficult to find points of minor criticism. Readers, no doubt, will notice that the new chapter entitled " The Magnetic Circuit," while being an excellent treatise on the characteristics of grain-oriented cold reduced steel and its application to strip wound cores confines itself to this material alone: one is directed elsewhere for information on hot rolled steel although one would expect to find it in this same chapter. To write of " tertiary windings " instead of " stabilising windings," a term recently adopted by the BSI to replace it, will delay its demise while to refer to standard flux densities is likely to prove somewhat perplexing in light of the fact that for cold rolled steel induction densities have been increasing by steps from around 13,000 lines per sq. cm to 17,000 lines or even higher. These, however, detract little from the real value of this new edition.

Now to the main substance of the new edition and particularly to the new material. Surge distribution throughout transformer windings is explained and methods of impulse testing and fault detection are described; noise has a chapter on its own as have electromagnetic forces. These sections are worthy of careful study forming as they do a very adequate introduction to the subjects under discussion.

Information relating to transformer enquiries and tenders has been amplified and tables of impedances are included for transformers with ratings up to 30 MVA and voltages of 110 kV. These sizes and voltages have long been surpassed but that the tables are so limited may be due to the fact that in the higher ranges impedances are determined largely by system conditions.

On-load tap changing development is reviewed and the reader is brought up to date with a description of the modern high speed resistor equipment. There is an important chapter too on the purpose and use of tappings, a subject which in times past has been a source of embarrassing misunderstanding, and which requires clarification because of the large tapping ranges now being specified.

With increasing voltage insulating oil and its conditioning merit serious consideration and the chapter on this subject is most informative. The essential characteristics of an acceptable oil are enumerated and methods of oil treatment are described; the claims for inhibited oils are explained and emphasis is given to acidity being a better criterion of oil condition than the erstwhile one of sludge.

To those interested in railway electrification the Scott and the newly introduced although by no means new Le Blanc connections are likely to prove of particular interest as a means of providing single phase and two phase supplies from a three phase source.

It should not be thought, however, that this book is for the transformer designer alone. The test engineer will find much to interest him in the chapters on performance and type tests and test conditions wherein are outlined the test requirements of BS 171 and the manner in which these tests should be carried out. For the system planner, too, there are informative sections on transient phenomena, protective systems and earthing, with appendices on the equivalent circuit and symmetrical components, while the purchaser and operator will find useful advice on the scheduling of technical information, the evaluation of transformer losses, the safe loading of transformers by temperature, and on methods of parallelling transformers of different group numbers and polarity.

A separate appendix provides a comprehensive list of the relevant specifications issued by the British Standards Institution, and frequent reference is made throughout the edition to Codes of Practice and to the work on standardisation at international level.

Thus it can be said that just as thirty years or more ago the *J. & P. Transformer Book* was a " must " in any engineer's library so will this latest edition prove to be to the present generation of engineers and, let it be admitted, to those older men whose memories are not quite so good as they were.

R. R. PATTINSON

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Materials

Molten Sulphur. F. W. BERK AND CO. LTD., 8 Baker Street, London W1. Brief advice on handling and storage of molten sulphur. 12 pp., ill.

Alloys in Pickling. HENRY WIGGIN AND CO. LTD., Wiggin Street, Birmingham 16. Which of this company's products to choose in design of pickling plant. Useful design drawings of handling equipment in Monel alloy. 28 pp., ill.

Hot Dip Galvanizing. HOT DIP GALVANIZERS ASSOCIATION, 34 Berkeley Square, London W1. How this type of protection should last in several environments. 8 pp., unill.

Heat Exchanger. IMPERIAL ALUMINIUM CO. LTD., Witton, Birmingham 6. Tube-in-Strip is a sheet material with parallel ducts going through it. Brief data. 3 pp., ill.

Moulding Material. TURNER BROTHERS ASBESTOS CO. LTD., Rochdale. Quite full data on how to use Durestos asbestos-filled phenolic moulding material. Property data and actual uses. 26 pp., ill.

Glass Reinforcement for Plastics. TURNER BROTHERS ASBESTOS CO. LTD., Rochdale. Introduction to uses and technical data on various forms of glass fibre reinforcement for plastics. 24 pp., ill., also technical leaflets.

Nickel-Copper Alloy. HENRY WIGGIN AND CO. LTD., Thames House, Millbank, London SW1. Full design data and uses of K Monel, a heat-treatable corrosion-resistant alloy. 16 pp., ill.

Epoxy Resin. LEICESTER, LOVELL AND CO. LTD., North Baddesley, Southampton. A data sheet with introduction. 7 pp., unill.

Water Treatment. AQUASTAT LTD., Romney House, Tufton Street, London SW1. The Aquastat process is electrical in nature and is claimed to modify the scale-forming tendencies of waters. Actual uses vouch for this. 24 pp., ill.

L.P.G. Fittings. WHESSOE LTD., Darlington, Co. Durham. Shand & Jurs fittings for volatile liquids stored under pressure. Safety valves, operators, and housings; also examples of circuits. Loose leaf catalogue, 16 pp. ill.

Gland Packings. CRANE PACKING LTD., Slough, Bucks. Gland packings for acids, alkalis, air, gas, water, foods and drinks, tars, etc. Catalogue, selection guide, and notes on design and performance, 60 pp. ill.

Calculator. PLENTY AND SON LTD., Eagle Iron Works, Newbury, Berks. Circular calculator for pressure drop in pipes and for pump horse power and capacity. Double sided.

New Books

Seven into Space: The Story of the Mercury Astronauts. By JOSEPH N. BELL. *Ebury Press, 30 Grosvenor Gardens, London SW1.* (12*s* 6*d*)

Staccato account of Project Mercury before the feats of Titov et al.

The Dynamical Theory of Sound. By HORACE LAMB. 2nd Edition. *Dover Publications, New York; Constable, London.* (12*s*)

Unabridged republication of the 1925 edition. A comprehensive mathematical treatment of the physical aspects of sound is presented, covering the theory of vibrations, Fourier's theorem, and the equations of motion of strings, bars, membranes, pipes and resonators. Plane, spherical and simple harmonic waves and diffraction are also treated. A chapter on physiological acoustics concludes the book.

The Theory of Subsonic Plane Flow. By L. C. WOODS. *Cambridge University Press.* (£6)

Two-dimensional, inviscid, subsonic fluid motion and its aeronautical applications are treated concisely and systematically. Familiarity with the elements of fluid dynamics is assumed. Of special importance is the extensive account of mixed boundary-value problems, which arise, for example, in ventilated wind-tunnel theory, jet-flap theory and unsteady Helmholtz motions.

Sensitometric Control in Film Making. By L. J. WHEELER. BBC Engineering Monograph No. 33. *British Broadcasting Corporation, 35 Marylebone High Street, London W1.* (5*s*)

The calibration and operation are discussed of the type X6 sensitometer and the type MND line densitometer installed at Alexandra Palace. A detailed description is given of the system of sensitometry established to control the continuous processing of films used in the BBC television news programmes. Consideration is given to the subsidiary factors that must be controlled and to the working tolerances that apply to each variable.

Automatic and Fluid Transmissions. By J. G. GILES. *Odhams Press.* (45*s*)

The first comprehensive British study of the subject, this covers the principles and practical aspects of the design, installation and operation of mechanical, electrical and hydraulic transmission systems, together with semi-automatic devices and overdrives. Most of the proprietary US, British and Continental transmissions are reviewed. A " must " for all concerned with automobile engineering, including students.

The Reviewers

Dr. I. S. Pearsall is a Bachelor of Science in Mechanical Engineering and obtained his Ph.D. for work on the hydraulics of surge tanks. He is a senior scientific officer at N.E.L. where he is working on axial flow pump and fan research.

Mr. F. W. Latham is a Bachelor of Science in Mechanical Engineering of the Carnegie Institute of Technology. He is a management consultant with Urwick, Orr & Partners, Ltd.

Mr. R. P. Johnson, M.A., A.M.I.Struct.E., is a Fellow of Selwyn College, Cambridge, and a University Lecturer in Engineering. His former experience includes work as senior engineer with Ove Arup and Partners.

Mr. R. R. Pattinson, M.I.E.E., is deputy chief electrical engineer of Merz and McLellan at Newcastle upon Tyne. His experience includes three years in India and four in Pakistan as chief engineer and manager.

Modern Furnace Technology. By H. ETHERINGTON and G. ETHERINGTON. 3rd Edition. *Charles Griffin.* (£6)

Taking cognizance of the progress in furnace technology during the past 20 years, the authors have extensively revised this standard manual and textbook on the scientific principles underlying furnace design and operation. There are new sections on gas friction calculation, refractories and typical industrial furnaces.

Dock and Harbour Engineering. By HENRY F. CORNICK. Volume 3: Buildings and Equipment. *Charles Griffin.* (£6 6*s*)

Although written primarily for student engineers, this comprehensive treatise should prove invaluable to practising maritime engineers. The present volume covers roads, railways and bridges; transit sheds, warehouses, grain stores, cold stores, and passenger terminals; working equipment; operating plant; bulk handling plant; auxiliary services and appliances (salvage plant, radar, fire prevention, etc.).

Handbook of Instrumentation and Controls. Edited by HOWARD P. KALLEN. *McGraw-Hill, New York and London.* (£5 16*s* 6*d*)

Practical design and applications manual for the mechanical services, covering steam plants, power plants, heating systems, air-conditioning and ventilation systems, diesel plants, refrigeration, and water treatment.

Marketing

Extensive Orders for Self-Changing Gears

The last few years have seen a period of metamorphosis in the design of short-haul and shunt locomotives, there being a steady decline in the number of steamers in service coupled with a general swing towards the diesel.

When such a change comes about, manufacturers of ancillary equipment receive many orders for the design and supply of specialist components with which to equip the new machinery. On the other hand there is sometimes a substantial increase in the demand for an item which has been available for some time but, prior to the introducton of the new ideas for the design of the main plant, has never reached its full sales potential.

It would appear that this has occurred in the case of SELF-CHANGING GEARS Limited, the makers of gearboxes for heavy locomotive plant. Their RF II unit has been well-known to railway engineers for over 20 years but it is selling now in larger numbers than it ever has. A recent order from a British concern covers the supply of 36 to SENTINEL (Shrewsbury) Limited for fitting to the latest Sentinel locomotives. A number are in service with British Railways and in addition to this, the RF II together with its counterpart, the WILSON gearbox, is used extensively by the New Zealand Government Railways, Norwegian State Railways and East African Railways. Industrial concerns recently supplied with RF II-equipped locomotives include Dorman Long, the National Coal Board, the Central Electricity Authority and the Northern Aluminium Company. Recent inquiries have been received from Siam and South Africa.

A gearbox used for this purpose must be light but rugged in construction and capable of withstanding the heavy buffing and drawbar shocks associated with shunting locomotives at work. The makers claim that the popularity of the RF II is largely due to ability to give reliable and efficient service under these arduous conditions.

Rapid Development of Computers

The development of the electronic computer, that complex device which has, in its field, caused a minor revolution this decade, is progressing so rapidly that many firms are beginning to think about replacing their existing installations so as to keep abreast of the times.

Two such up-to-date concerns are the Swedish Insurance companies TRYGG and FYLGIA, who have for the last two years been operating jointly, through their subsidiary AB Datacentralen, a FERRANTI PERSEUS data processing installation. It is now the intention to replace the Perseus with the latest Ferranti system, the Orion, in about two years time.

Four years would appear to be a remarkably short life span for such an expensive piece of equipment, which does not wear out and lose efficiency in the manner of a purely mechanical device, but AB Datacentralen obviously feel that present trends render such a step necessary. Their reasons are perhaps best expressed in the words of Mr. K. E. Schang, the managing director, who said recently:—

"The Orion is the natural replacement because we can do the same sort of data processing but handle more work at much higher speed. One of the reasons for this greater capacity is that the Orion can perform several programmes simultaneously on a time-sharing basis. It may sound contradictory but the change is being made because the Perseus has done a fine job. Savings already correspond to a revenue of 25 per cent on the total investment, and will be still better in 1962. Although investments will be increased considerably by the purchase of the Orion, the revenue percentage will again be improved. Technical improvement is indeed fast, but it is important that it be made to pay and pay more."

The main purpose of the present installation is to process some 1,500,000 insurance policies, the details of which are held on magnetic-tape records. The Perseus system is able to update the records only at monthly intervals. The Orion system will enable this to be done each day, with the result that the number of alterations to be made during each run of the computer will be comparatively small. Computations will thus be simplified and the improved operating methods will leave spare capacity for additional work.

To Have and to Hold Freeze-Dried Foods

The commercial production of foods preserved by freeze-drying will tend to become more and more evident in the future. This is the process which involves freezing the material, then removing its water content by sublimation under vacuum while the material remains frozen solid. A refrigerated vapour condenser or steam ejector removes the water vapour from the freeze-drying system.

Two companies have just put on the road two mobile demonstration units which will work as a pair and tour the country.

One belongs to MITCHELL ENGINEERING Limited, who as manufacturers of freeze-drying plant have designed the unit for on-the-spot demonstrations at factories where canning or other conventional food processing is going on. At such demonstrations sample quantities of foods are taken from batches which are to be conventionally processed and are freeze-dried on the Mitchell unit. They are then reconstituted so that the manufacturer can get some idea of how freeze-dried foods compare with his own.

The advantage of such demonstrations is in the exact comparison which can be made between freeze-dried and conventionally processed foods owing to the freeze-dried samples being taken from batches being used for routine production and being processed at the same time.

Having freeze-dried the foods there comes the problem of how to package them. It is here that the second company fits into the picture. They are TAYLOWE Limited of Maidenhead who have fitted out the second mobile demonstration unit as a mobile packaging laboratory.

One of the main packaging requirements is that the food should be protected from moisture during transit and storage, and that oxidation of the food should be prevented since this results in off-flavours, loss of colour and—where fats are present—rancidity. In practice this means that vacuum or gas packing is necessary.

The packaging system offered by Taylowe's is based on the Swedish CEKA design. Known as Cekatainers the system answers all the requirements. They provide an attractive carton pack having an independently sealed liner which consists of plastic film or foil. When the food is packed all the air is evacuated and the pack filled with inert gas to a pressure below atmospheric. The effect of partial vacuum brings about a partial collapse of the liner which means that the product is firmly held within the bag and the bag is firmly held by the carton.

New Look for Olympia

The famous Grand Hall at Olympia, London, has recently undergone redecoration costing £40,000 in readiness for the big autumn and winter season of domestic and industrial exhibitions. The large scale painting work involved was carried out by DEEDS (Hounslow) Limited.

Regarded as something of a record in painting jobs, this "new dress" for one of Britain's great shop windows had to be completed in six weeks between exhibitions—from early July until late August. The finished effect of the light blue and pale grey colour scheme is felt to enhance the lightness and spaciousness for which Olympia is noted.

Apart from its size, the work presented special problems and required detailed planning beforehand—for two months until the beginning of operations the painting contractors' experts were measuring and estimating. Dust removal, brushing, scraping and washing were followed by the application of 3,000 gallons of paint.

Large Contract for Turriff

TURRIFF CONSTRUCTION CORPORATION Limited has been awarded a contract worth £480,000 by BRITISH HYDROCARBON CHEMICALS, acting through the Engineering Division of the DISTILLERS Company Limited. The contract provides for the construction of buildings comprising part of a new factory to be built at Baglan Bay, Swansea.

The buildings were designed by the DCL Engineering Division and include a building block, canteen, workshops, chemical stores, a fire station, administration and works offices and sundry outbuildings.

Work on the project is to start at the beginning of September, 1961, and the new factory is scheduled to commence operation in September, 1962.

GEC To Improve Communications in Peru

The GENERAL ELECTRIC Company Limited has received a three million dollar order from the COMPANIA NACIONAL DE TELEFONOS DEL PERU. The company is required to supply the radio and multiplexing equipment for a microwave network to link the towns of Arequipa, Lima, Trujillo, Chiclayo and Piura.

The network will be the longest in South America, extending for 1,100 miles along the Pacific coast. Incorporated in its construction will be ten terminal and 54 two-way repeater stations. All routes are to possess main and protection radio frequency channels operating in the 2,000 Mc/s band, and in the event of a failure changeover to the protection channel is automatic. 240 speech channels are included in each radio channel.

The equipment for the contract, which was secured in the face of strong American competition, will be manufactured by the Transmission Division at Telephone Works in Coventry.

Computer for Nuclear Research

An "Atlas" electronic digital computer, manufactured by FERRANTI Limited, has been ordered for the NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE. Together with the necessary buildings, it will cost about £3½ million; it is to be installed at the Institute's Rutherford High Energy Laboratory, Harwell, for common use by the universities, the United Kingdom Atomic Energy Authority, Government departments and the NIRNS itself. It should be ready for use early in 1964.

The computer has been developed in cooperation with scientists at the University of Manchester, where the prototype is now being assembled. The UKAEA and certain universities have substantial requirements for time on such a machine, but the "Atlas" is reported to be able to handle so much work that it was decided to provide one machine for common use in the first instance, and the NIRNS were invited to manage it.

The UKAEA have been intimately concerned with the development of the project now entrusted to the Institute, and will continue to be closely associated with it. They are also handling the contract negotiations for the Institute.

Tyne Tunnel for Two Traffic Lanes

A vehicular tunnel is to be constructed under the River Tyne between Jarrow and Howdon. For this work the County Councils of Durham and Northumberland have accepted the tender of EDMUND NUTTALL, Sons and Company (London) Limited; the contract period is 3½ years.

The tunnel, which will accommodate two lines of traffic, is to be of 31 ft 3 in internal diameter and lined with cast-iron segments. The length between portals will be approximately 5,400 ft. It will run roughly parallel to the existing pedestrians' and cyclists' tunnels but it has been located at a lower level, largely in rock of the coal measures, in order to keep compressed-air working to a minimum.

A working shaft will be sunk on the north side and a 12 ft pilot tunnel driven through the glacial beds which overlie the coal measures on the north bank.

Ancillary works will include ventilation shafts and the diversion of the River Don where it crosses under the railway near the south portal. The consulting engineers are Messrs. MOTT, HAY AND ANDERSON.

The Cape "Alligator" Rotary Respirator

Nearly all the so-called "iron lungs" now made in Britain are the products of a young and vigorous company, who took full advantage of a chance opportunity in 1952.

THE idea of being put into an iron lung is both sobering and terrifying—sobering because of the seriousness of the condition demanding such treatment, and terrifying because of the image the term " iron lung " conjures up.

In reality, the present day respirator or breathing machine made by the Cape Engineering Company of Warwick resembles little the 1880 Woillez Spirophore and its steel cylinder from which the unpleasant nickname arose. As the illustrations show, the breathing machine is a highly refined engineering product. It is designed to maintain the patient's life and simplify the work of doctors and nurses in effecting a cure.

At the same time the Cape machine is apologetic—it knows that the patient within is seriously inconvenienced and in danger of losing all hope of recovery, and does what it can to minimize his discomfort. The importance of such elementary psychology in treating serious illness cannot be overstressed. There is an old saying " While there's life there's hope," but the converse is also true.

The purpose of the breathing machine is to impart a near-normal breathing action to any patient with serious respiratory failure. It is, in fact, the only way of keeping him alive. It must be thoroughly reliable and capable of giving prompt failure indication.

The most frequent cause of loss of respiratory power is the contraction of poliomyelitis, or infantile paralysis. There can be few diseases so demoralizing, due to the chances of non-recovery and the risk of permanent after-effects. A victim whose breathing is affected has no option but to enter a breathing machine until such time as his respiratory power starts to return and other breathing aids take over.

It would be difficult to construct a breathing machine using a mechanical method of direct artificial respiration, and exceedingly trying for the patient over a long period. Positive pressure breathing assistance through the mouth or a tube inserted into the windpipe is also inconvenient, though unfortunately necessary in cases of Bulbar polio where the throat muscles are paralysed. It is now generally recognized that the best solution is to alternate the air pressure on the exterior of the body in a rhythmic cycle in an attempt to simulate natural breathing, and so directly assist the impaired chest muscles. Unfortunately this method means confining the whole body except the head in a sealed pressure vessel called a cabinet respirator.

The history of the cabinet respirator in this country started in 1937-38 when an Australian engineer called Both was commissioned to construct a prototype by the London County Council's Hospitals Department. It was loaned to Radcliffe Infirmary, Oxford, where Lord Nuffield happened to notice it, and at his own expense he had nearly 1,000 made in his workshops and donated to hospitals in Britain and the Commonwealth. These respirators, though quite efficient, consisted of a wooden cabinet slightly reminiscent of a coffin as Fig. 1 shows.

The negative pressure breathing assistance principle of the Both respirator is still used today in the latest Cape machine. The average adult breathes at 16 to 19 respirations per minute and inhales and exhales 500 to 1,000 cc of air with each breathing cycle. The externally-placed mechanical pump exhausts air from the cabinet on the downward stroke, thus creating a negative internal pressure which draws out the patient's chest and abdominal muscles. Since his head is outside the cabinet and therefore subject to atmospheric pressure, air is automatically sucked into his lungs through the open windpipe and nasal openings.

On the reverse stroke of the pump the pressure in the cabinet returns to atmospheric, the patient's chest relaxes and the air in his lungs is expired through the usual channels. So by varying the pump speed to control the number of respirations per minute, and by varying the cabinet negative pressure to control the depth of breathing, the physician can choose a set of conditions best suited to the patient.

PRIVATE COMPANY

The Cape Engineering Company, a private company, started in a small way in 1946 as sheet metal fabricators and development engineers. It now employs about 170 personnel and specializes in more sophisticated design, research and development, dividing each activity equally between supplying the engineering needs of the medical profession and the Ministry of Aviation.

Mr. T. G. Turner, and Mr. G. S. Webley, joint directors, were formerly colleagues in the Alvis organization and it was through their association with the late Capt. G. T. Smith-Clarke, one time director of Alvis Limited, that Cape became involved in medical work.

Capt. Smith-Clarke was chairman of the Coventry Hospital management committee, and due to an outbreak of polio in the city, he was suddenly faced with having to rebuild and modify five Nuffield-Both respirators that were no longer serviceable. Cape were engaged in designing and assisting in carrying out the alterations, and the results were so encouraging that they received a contract under the auspices of the Ministry of Health for modifying about 500 more respirators between 1952 and 1954.

The first alterations consisted generally of improving access to the patient through the walls of the respirator and improving the pump mechanism. However, getting the patient in and out still necessitated withdrawing the stretcher bed endways and passing his head through the hole in the headboard, so the next step was to split the headboard.

By now, the limitations of existing respirators was becoming more evident. It was decided to design an entirely new machine—one that would be more acceptable to patients and more convenient for the hospital staff. The result was the Smith-Clarke " Alligator " respirator (Fig. 2) which appeared in 1954, so called because of its appearance with the cabinet open. At first two models were planned, a Senior and a Baby, but a child-size version was added—believed to be the first of its kind.

It was thought that the Alligator machine was the final answer, but it still possessed one shortcoming. A patient lying in one position is liable to bedsores and, more important, when his breathing muscles are paralysed he cannot cough and is therefore deprived of the natural process of lung drainage. So a respirator patient has to be periodically turned over from the supine to the prone position and back again, a task requiring a well trained team of five nurses.

In 1958 Dr. Howlett-Kelleher of Western Hospital, Fulham, approached Cape on this problem, and they set out to re-design the Senior size so that the patient could be turned over mechanically. The result is the rotary or " Kelleher " machine (Figs. 3 and 4), the subject of this Product Profile.

THE PUMP

The pump is perhaps the most vital part of the system and has to be robust, reliable and quiet in operation. As Fig. 5 shows, it is

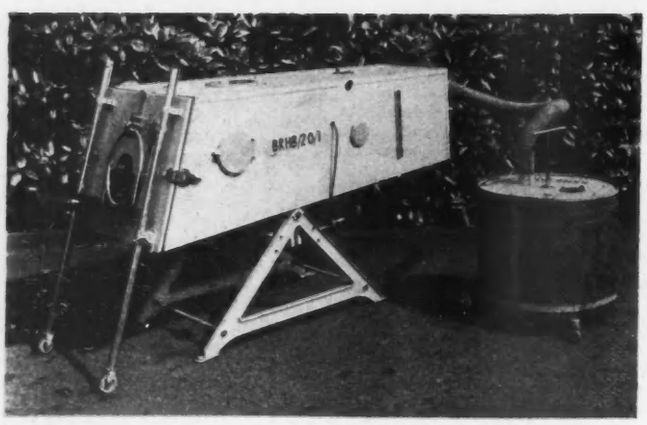


Fig. 1 (left) The pre-war Nuffield-Both respirator.

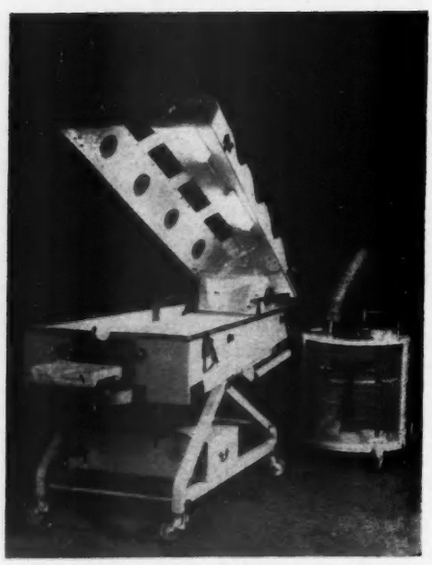


Fig. 2 (right) The 1954 Cape " Alligator " machine.

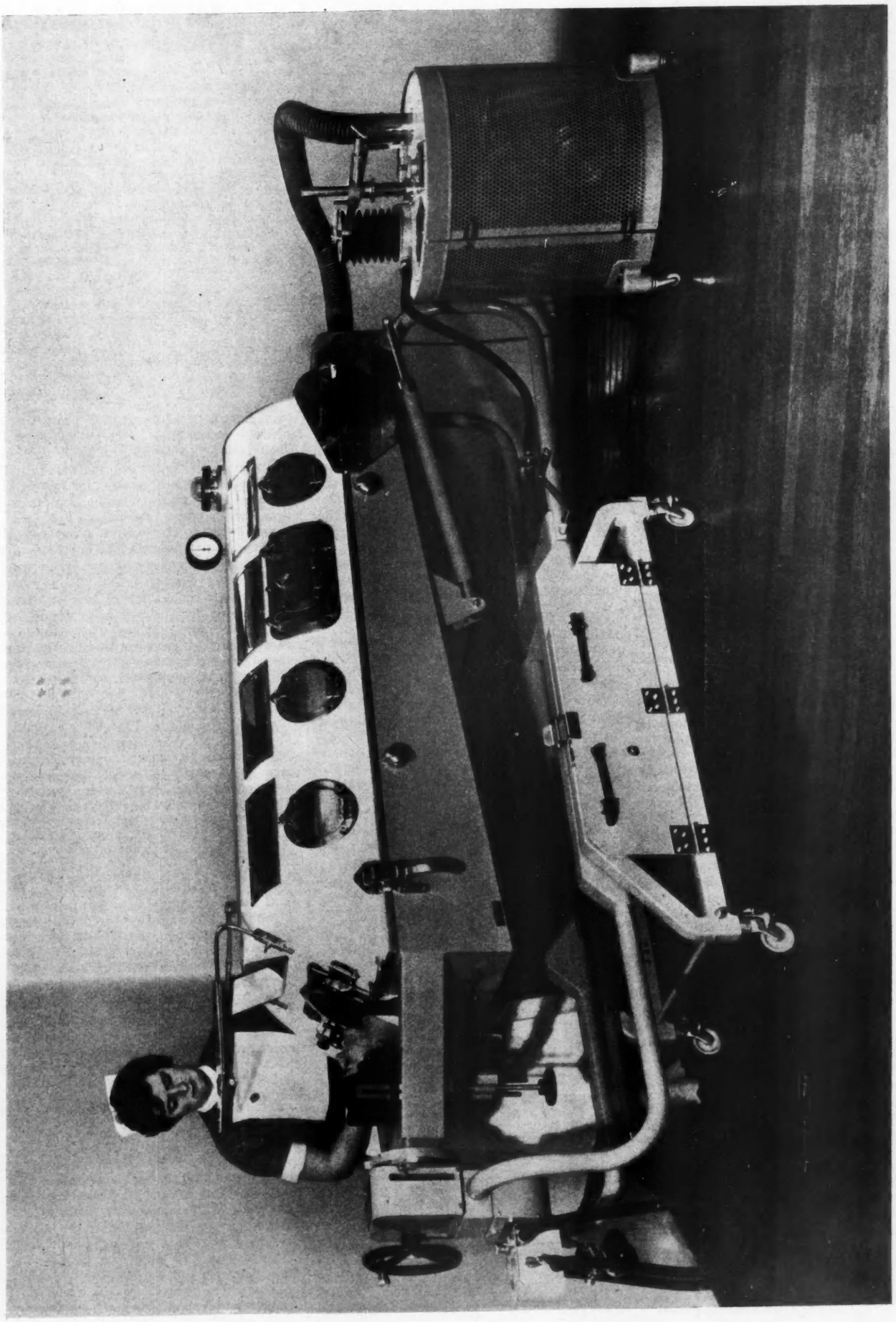


Fig. 3 The principle is simple—but it is from subtle labour-saving refinements that success has sprung.

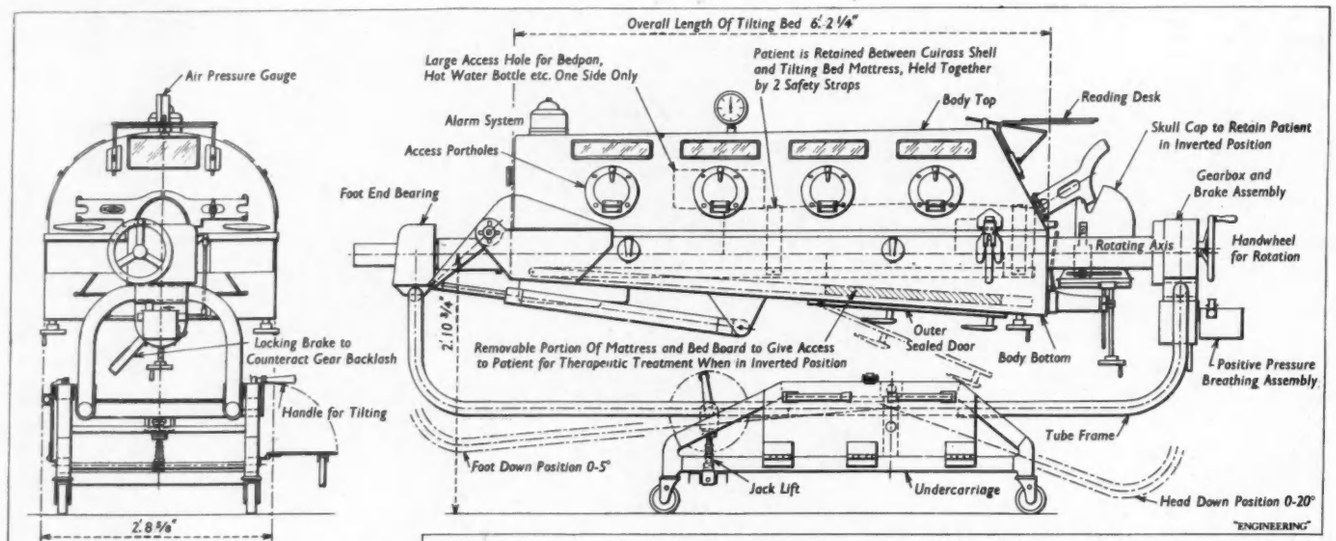

Overall Length Of Tilting Bed 6' 2 1/4"
Large Access Hole for Bedpan, Hot Water Bottle etc. One Side Only
Patient is Retained Between Cuirass Shell and Tilting Bed Mattress, Held Together by 2 Safety Straps
Air Pressure Gauge
Alarm System
Body Top
Reading Desk
Skull Cap to Retain Patient in Inverted Position
Access Portholes
Foot End Bearing
Gearbox and Brake Assembly
Rotating Axis
Handwheel for Rotation
Locking Brake to Counteract Gear Backlash
Removable Portion Of Mattress and Bed Board to Give Access to Patient for Therapeutic Treatment When in Inverted Position
Outer Sealed Door
Body Bottom
Positive Pressure Breathing Assembly
Handle for Tilting
Tube Frame
Foot Down Position 0-5°
Jack Lift
Undercarriage
Head Down Position 0-20°
2' 8 5/8"
View Showing Respirator Inverted
"ENGINEERING"

Fig. 4 Drawing of the rotary respirator.

of the vertical-axis bellows type connected to the cabinet by a short length of non-collapsible rubberized canvas hose. An adjustable non-return valve on the pump and an adjustable leak valve on the cabinet control the pressure variation on the patient. A ½ hp electric motor is connected by belt to a gearbox, which drives a cross-slide arrangement designed to give the ideal inspiration/expiration period ratio of about 1:1·5. This simple arrangement represents a great improvement over the crank and connecting rod mechanism used with the Both pump, which gave equal respiration periods. Stepped belt pulleys on motor and gearbox give a choice of respiration speeds and provision is made for emergency hand working.

The cabinet is shown in Fig. 4. The neck opening is made reasonably air-tight by a soft rubber sealing collar. Pressure indication is provided by a gauge on top of the cabinet. A negative pressure of 15–20 cm water gauge is usually employed, returning to atmospheric.

The headboard slopes back to 30 degrees above the neck centre line to improve the patient's visibility and feeling of freedom, and a transparent reading desk and mirror are provided. The body consists of welded 10 swg aluminium sheet and is split and hinged at the foot end for getting the patient in and out. The upper portion is provided with generous armports and windows, together with two strip lights.

A light glass fibre cuirass, moulded to the approximate shape of the patient's body, is attached to the mattress by means of two aircraft-type safety straps and supports the patient in the inverted position. Therapeutic treatment when the patient is prone is facilitated by a removable portion of mattress and an access door with two armholes through which the physician can work. The handwheel for rotation can easily be operated by one nurse and the Crofts reduction gearbox has a locking device which obviates any effect of backlash.

The alarm system is dry battery operated and gives both audible and visible warning if the maximum negative pressure falls below about 10 cm. Also fitted is a positive pressure breathing attachment which can be used with a face mask or mouthpiece attachment for direct inhalation while the negative pressure seals are broken, for instance when the Alligator top is opened for prolonged nursing attention.

HOSPITAL SUPPLIERS

The success of the Cape rotary respirator is clear proof that supplying hospital equipment is not by any means a "closed shop"; the sole preserve of a few specialist firms. In greatly reducing the number of nursing staff in attendance on breathing machine patients, it contributes directly towards increasing hospital efficiency.

Tailoring engineering design to meet the needs of the medical profession demands not only the closest possible liaison between the manufacturer and the physician—but also puts a certain onus on the latter to make his requirements known in a language acceptable to the engineer. In the past a certain barrier existed, but a definite change in medical attitude towards the engineer has occurred during recent years, due perhaps to a rise in status of the hospital engineer.

Production planning for hospitals in Britain is a continual headache. Only in a few instances do Cape receive any forward planning information. Such a situation is not conducive to economic production and now that nearly every hospital in the country has at least one respirator of one kind or another, cost is frequently the biggest deciding factor in ordering a replacement machine. Cape sanction their sub-orders 25 machines ahead and build each size of breathing machine in batches of five up to raw finished condition. Production of the Senior size is generally 20 to 25 per year.

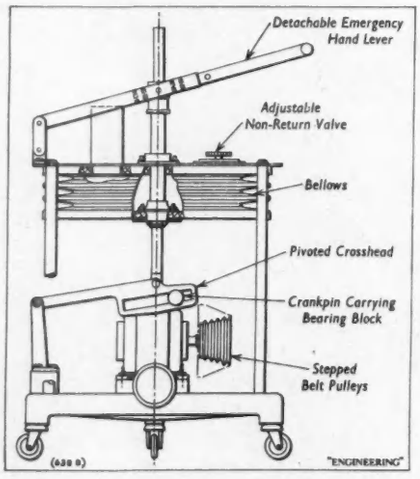


Fig. 5 The working principles of the pump.

Most polio centres aim to have at least one Senior respirator standing ready for use at a moment's notice. Though the advance of vaccines in recent years has considerably reduced the incidence of paralytic polio, there are regretably still a large number of cases requiring assistance in breathing. For instance, in an average month, June 1961, 56 cases of paralytic polio were notified in England and Wales, in about half of which breathing was affected. Machines can be quickly concentrated in any area affected by a sudden epidemic—but are apt to deteriorate rapidly if left idle. This fault was particularly serious with the old wooden respirators. Cape Engineering help in maintaining the serviceability of all breathing equipment both old and new.

Cape have also devised other breathing aids, e.g. rocking beds, portable cuirass respirators (operated from a standard 12-volt car battery), humidifiers, suction pumps and positive pressure and anaesthetic machines. Their close contact with hospitals has led them into developing other more simple pieces of equipment aimed at labour-saving, for example, trolleys and food conveyors under the name of Capecraft Limited.

There is an increasing tendency for physicians to place patients with other breathing embarrassments of a less serious nature in respirators. The Cape rotating Alligator machine has gone a long way towards reducing the psychological terror of breathing machines for both patients and relatives, encouraging its earlier use. The earlier breathing assistance can be given, the better chance there is of complete cure.

Cape are aware that a tremendous potential for breathing machines must exist in other parts of the world, and they have enjoyed some success in the Commonwealth. Despite overseas competition, particularly from the USA and Germany, they have broken ground in several countries in the northern hemisphere, for example, Italy and Russia. The Cape machine has been described in medical circles as "the finest respirator available in the world today."

Further Emphasis on Control Engineering

The British Iron and Steel Research Association has created a new section in its Plant Engineering and Energy Division, in order to centralize the Association's research on control engineering.

When the Plant Engineering and Energy Division was formed, an electrical engineering section was included to carry out research into electrical devices and equipment used in steel-works. However, the last few years have brought an increasing interest in automation in the iron and steel industry, and the research of the section has tended more and more toward the electrical engineering aspects of automatic control systems —their design, construction and application to steel-making plant. Some work on hydraulic control systems has also been carried out in another section of the Division.

Since the basic theories of control apply to both hydraulic and electrical techniques, there are obvious advantages to be gained by bringing the two together under one section. This is in fact what is now being done by replacing the Electrical Engineering Section with a new Control Engineering Section.

This change of name represents a recognition of the recent changes of emphasis in this field of work which are gradually leading to the establishment of control as a primary engineering science.

The new section will continue with existing research programmes on the more general electrical engineering problems of steel works.

Basic Improvements in Thermionic Valves

After several decades of development, the traditional thermionic valve has reached the stage where further basic improvements are rare and hard-won. Most of the geometrical design parameters have been exhausted and any further improvements to valve performance must almost certainly come from new materials or new production techniques.

With so much of the available research effort now being put into the newer semi-conductor devices it is perhaps surprising to find two fairly substantial basic valve developments exhibited on the Mullard stand of this year's Radio Show. Each of these developments has been achieved through new techniques for the production of cathodes.

The first effect of the new production methods has been an increase in the voltage output of thermionic rectifiers. This has resulted from what is called a "pressed powder" cathode, which enables the anode-cathode spacing to be substantially reduced. In the past, attempts to increase the rectified output voltage by reduction of electrode spacing have always resulted in "sputtering," or flashover, between the anode and any high spots on the cathode. Due to the resistance of the cathode material and unavoidable slight irregularities on the cathode's surface, local heating would occur and eventually result in the disintegration of large areas of the cathode.

The new pressed-powder cathode, using normal barium strontium oxide as its source of emission, is prepared in such a way that a hard shiny surface is produced and the emitting oxides are in a very dense form. The smoothness of the coating eliminates surface high-spots and the method of manufacture ensures that the internal resistance of the cathode is low, thus reducing local heating.

Because of these features, the likelihood of sputtering is considerably reduced and, should it occur, the damage to the coating will be much less than is experienced with conventional rectifier cathodes.

The first Mullard valve to use this technique is a half-wave mains rectifier, type PY33, which is intended for television receivers with series connected heaters. It provides a maximum output of 250 v at 325 mA. Peak inverse voltage is 600 v and the heater rating is 29 v at 300 mA.

Using a locked-seam manufacturing process, the second new development exhibited by Mullard is intended to increase the emission, reliability and life of cathodes used in frame-grid valves.

Unlike the conventional cathode, which is drawn and pressed from nickel tubing, the locked-seam cathode is formed from nickel strip which is cut and folded to the appropriate shape and size on an automatic machine.

Elimination of the drawing process yields two significant advantages. First, possible contamination of the nickel by machine lubricants is avoided. Second, the trace elements introduced into the nickel to ensure a high level of emission from the oxide cathode coating can be preserved in their currect proportions because the locked-seam process does not involve the application of heat and hence oxidation of the elements does not occur.

Since the trace elements also reduce the amount of volatile metal distilled from the cathode during operation, the locked-seam process also ensures that the inter-electrode resistance of the valve is maintained.

High-Frequency Power Sources for Research

Two recently developed continuous-wave power valves, which provide convenient and powerful signal sources over the 50 to 60 kmc/s range have been announced by the Bell Telephone Laboratories, Murray Hill, New Jersey, USA. The first is a 50 milliwatt backward wave oscillator and the second is a 0·5 watt travelling wave tube. Each device makes use of permanent magnet circuits and is capable of providing versatile signal sources for general laboratory use.

The backward wave oscillator operates in the frequency range from below 45 to over 60 kmc/s. It gives at least 50 milliwatts from 50 to 60 kmc/s and the output power fluctuates less than 2 decibels over the same range.

The travelling wave tube is a helix-type which provides more than one-half watt of power from 50 to 60 kmc/s. The low-level gain is 40 to 45 decibels at midband and shows a slope of about 6 decibels across the 50 to 60 kmc/s band.

There is sufficient power from either tube to extend greatly the range of measurements possible at 50 to 60 kmc/s, and to permit the use of levellers, ratio meters and other devices which are commonly used to facilitate measurements at lower frequencies.

Two new devices, which are suitable as laboratory sources of very high frequency electrical power, have been developed in the USA.

During the past year, several tubes of each type have been in operation at the Bell Laboratories in a research programme aimed at the development of a millimeter-wave transmission system. Each unit includes permanent magnets to focus the electron beam, and internal transducers to match it to standard waveguide. No external matching devices are required.

As yet, no life studies have been made. However, several tubes have been in operation over 1,000 hours with no signs of failure.

Continuous-Discharge Rotary Vacuum Filter

A rotary vacuum filter which offers increased efficiency and lower operating costs has been developed by the Eimco Corporation of America and is now being manufactured in Gateshead by Eimco (Great Britain) Limited.

The main feature of the new filter is the means for removing the filter from, and returning it to, the drum in the course of each revolution. This results in an improved discharge of the filter cake. The use of a scraper blade or an air-blower is dispensed with and the belt is washed before being returned to the drum. Thus, a clean filter medium is always in use, giving sustained high filtration efficiency and reducing the time required for cleaning the belt.

Unlike conventional drum filters it is not necessary to install a larger unit than is strictly necessary in order to overcome progressive blinding of the filter medium. The absence of a scraper blade reduces wear on the filter belt and increases its life. When belt changing is necessary, a zipper joint enables this to be done in less than half an hour, compared with the four hours normally required to change a conventional belt.

The EimcoBelt filter, as it is called, is manufactured in standard sizes ranging from 18 in diameter with 12 in face, to 14 ft diameter by 16 ft face. The smaller models are intended for use in laboratories and pilot plants, while the larger types can cater for almost any industrial filtration requirement. The freedom of these filters from medium blinding enables them to handle difficult slurries which otherwise cannot be filtered continuously.

In an American corn mill, two of these filters were recently used to replace a battery of plate and frame presses handling a difficult and sticky corn gluten. The blinding nature of the gluten made it necessary to wash the original filter cloths after each batch, whereas the stainless steel medium of the new filter, operating continuously, required steam cleaning only once or twice a week.

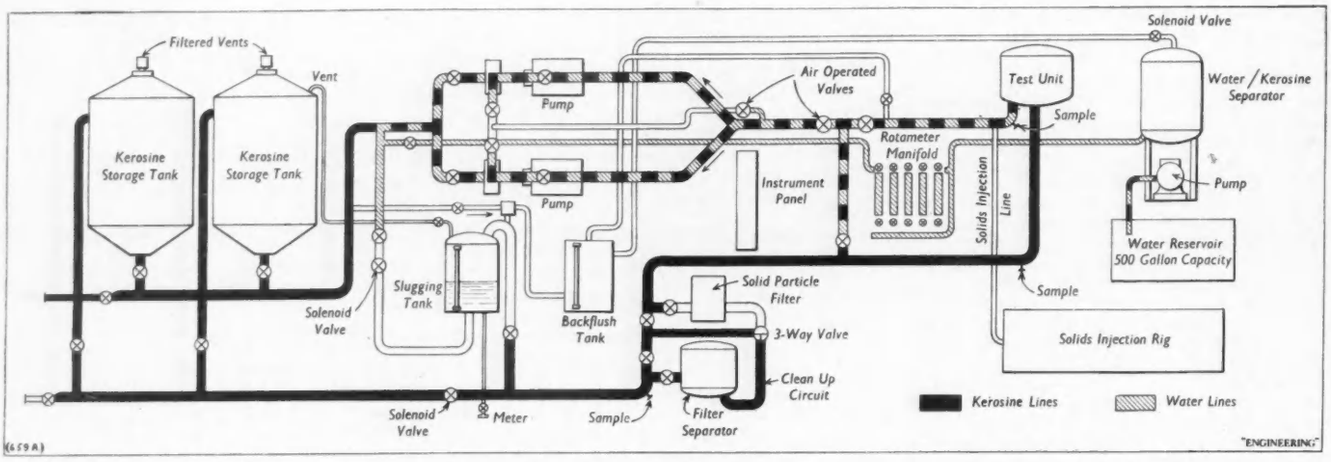
Effect of Speed on Road Accidents

The current annual report of the Road Research Laboratory gives details of a critical survey which has been carried out on the effect of speed regulations on traffic speed and accidents in various countries. The survey was based mainly on reports submitted to the International Study Week in Traffic Engineering in September, 1960, but was supplemented by further reports from Great Britain and other countries.

Measurements of the speed of traffic on various roads have been made in Belgium, Holland, the USA, New Zealand, Northern Ireland and Great Britain both with and without a speed limit in force. In almost every case, the proportion of vehicles travelling at high speeds was lower when the limit was in force. However, in every case, a high proportion of vehicles exceeded the speed limit.

The number of accidents before and after the imposition of speed limits in the built-up areas of Switzerland, the Netherlands, Great Britain, Northern Ireland, the Federal Republic of Germany and Sweden have been examined. In every case the imposition of a speed limit coincided with a reduction in the number of fatalities in built-up areas relative to those in non-built-up areas.

Speed limits imposed on national roads in France and Germany and on busy roads near London during the weekends were followed by reductions in the number of serious accidents.



Flow circuit for water separation tests. In connection with aviation fuels, this is probably the most important facility of the new Purolator filter test unit.

Towards Higher Purity for Engine Fuels

The introduction of turbo-prop and jet aircraft and a rapid general rise in aviation activity have acutely increased the need for more efficient methods of purifying fuels. To meet this need more development work is now being carried out on bulk filtration and separation techniques.

THE standard of purity of aviation fuel can never be too high, since both the safety and efficiency of aircraft depend on it. Contamination, even in very small amounts, can cause rapid wear of components, fuel pump failure, seized valves, and various other defects. In particular, the presence of water in aviation fuel can present a somewhat deadly hazard through icing of fuel lines, loss of engine power and corrosion.

Since both water and solid-particle contaminants must invariably find their way into fuel during storage and handling, the problem of maintaining high-grade purity in the aircraft's fuel supply can only be solved through the use of efficient filters. Although this problem is certainly not new, it has become very much more critical in recent times through the greatly increased flow of traffic on the world's airlines. Not only must aircraft be refuelled at faster rates in order to keep ground times to a minimum, but their longer ranges and larger payloads demand greater quantities of fuel. Currently, aircraft are refuelled at rates approaching 1,000 gallons per minute but, during the coming decade, an average rate may be as high as 1,200 gallons per minute.

Modern aircraft, therefore, present the most difficult problem to the fuel-filter design engineer but, at the same time, attention must also be paid to the removal of solids from diesel-engine fuel. By so doing, much of the load can be removed from the engine's own filter, thus substantially increasing the reliability of the engine.

Experience has led to the acceptance of various standards of practice for the bulk filtering of fuel whenever it is transferred from one tank to another. Such operations occur regularly, for example, from refinery storage to ship, from railway station to locomotive, from airport facilities to aircraft, and from storage depot to delivery vehicle. In the event of a tank not being cleaned properly or a pipe-line not being flushed, a well-designed filter can often prevent serious damage from occurring further along the line.

Research Report
on work of the
Purolator Filter Division of the Automotive Products Company Limited,
Tachbrook Road, Leamington Spa, Warwickshire

Multi-Standard Test Unit

In the light of the increasing and far reaching importance of bulk fuel filtering techniques and bearing in mind that there is no universally accepted test procedure for the performance of aviation fuel filtration equipment, the Purolator Division of the Automotive Products Company recently decided to build a test house in which filtration equipment can be examined in accordance with any currently used test specification. This test house, which has been built at a cost of more than £20,000, is now in use and is expected to contribute significantly to the development of improved techniques and new ideas in bulk filtration.

Designed by the technical staff of the Purolator Division, the new test house covers an area of some 20,000 sq. ft. and it is said to be one of the most advanced installations of its type in the world. The unit, which is capable of carrying out flow tests at rates as high as 1,200 gallons per minute, consists of five main sections.

1. *Tank Section.* Apart from facilities for the bulk storage of kerosine, this comprises an underground water supply that can be cleaned and filtered for re-use after test and a solid-contaminant injection rig.

2. *Pump Section.* The main pumps for supplying fuel for test, two smaller pumps for introducing solid-contaminant into the system, and a self-priming water pump for drawing water from the storage tank when testing filter separators, are contained in this section.

3. *Clean-Up Section.* This covers the complete installation for the individual separation of water and bulk solids from contaminated kerosine which has been used for test purposes. It also takes care of the cleaning and filtering of the water supply.

4. *Test Area.* This is the point where units are coupled, either in series or parallel, for separation and filtration tests.

5. *Sampling Area.* This includes the laboratory working section, which is above the test area, in which samples are taken and analysed during tests.

Water Contaminants

Quite apart from solid contaminants, filter separators must also contend with water, which may be emulsified or in the form of "slugs" such as are found in bulk fuel tanks after long periods of standing. The whole test sequence has therefore been designed to simulate such conditions, but in a more drastic form.

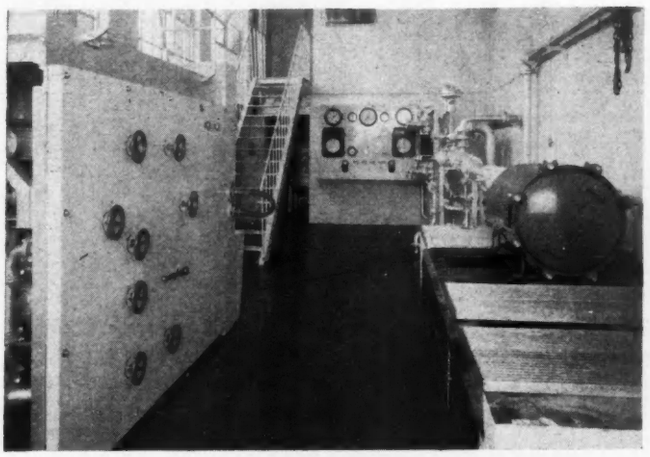
Two kerosine storage tanks, each with a capacity of some 8,000 gallons, provide the fuel for testing purposes. These tanks are situated outside the test house on a heavy supporting structure over a bund, which ensures that any spillage or leakage will not find its way into the main drainage system. Filling points are arranged so that the tanks can be directly filled from mobile tankers. Vent filters and flame traps are fitted into the tops of the tanks and, as a further safety measure, provision is made for fire-extinguishing foam to be automatically injected into the tanks in the event of an emergency.

Fuel is drawn off through an 8 in main, into which either or both tanks can be coupled, and pumped through two Pegson pumps to the test area. These pumps are each capable of delivering up to 600 gallons per minute at 135 lb per sq. in, or they can be coupled together to provide a total delivery of 1,200 gallons per minute, also at 135 lb per sq. in. Each pump is driven by an 85 hp electric motor, which is flameproofed, as is all the electrical equipment, in accordance with the Buxton Certificate for groups 2 and 3 gases.

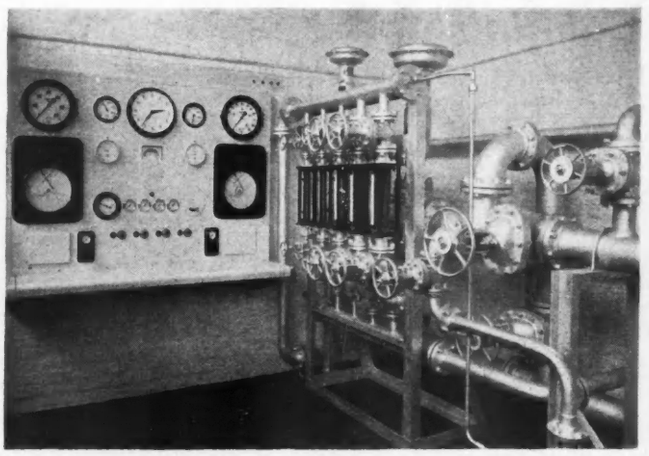
Bulk Water

For simulating conditions where "solid" water contamination is likely to be encountered, a water slugging vessel is interposed in the main test line; it operates as follows. Water is stored within the vessel which is normally isolated from the mains by a valve. At the appropriate moment the valve is opened and a supply of kerosine is forced into the top of the vessel; the consequent pressure rise shoots the slug, or charge, of water through the main line to the filter under test through which it will pass as a solid stream. For normal testing conditions water is introduced into the feed lines at the pre-pump stage so that, as it passes through the Pegson pumps, it will be emulsified to a high degree before passing into the test unit.

For the testing of large capacity filters the pressurized liquid is taken through 6 in mains, but for smaller capacity filters the flow is through



This general view of the interior of the new bulk filter/separator test laboratory shows a new filter unit being tested (right).



The main control panel and the flow meter bank can be seen in this illustration. The latter is used for measuring water flow through units on test.

a low-flow 4 in main. All the pipe-work in these circuits is internally protected against corrosion by coatings of Prodofilm or Prodoglas.

Water for test purposes is taken through a bank of Rotameters with capacities ranging from 0·05 to 50 gallons per minute and these can all be coupled together to give a combined flow of 105·55 gallons per minute.

As the fluid is pumped through the mains it can be visually checked by the operator through sight glasses positioned both before and after the test stage. This is, of course, by no means the only form of check. For testing the efficiency of the filter, sampling points are interposed at various stages of the test from which actual samples of the contaminant, before and after filtration, can be drawn off isokinetically and examined in a fully-equipped test laboratory housed in an upper floor above the test unit.

For the testing of bulk filters two tanks of some 50 to 60 gallons each are employed from which liquefied contaminant is drawn off through two Pegson pumps, each one capable of passing 20 gallons per min at 75 lb per sq. in; they can be operated in series or in parallel. When operated in parallel the combined pressure of 150 lb per sq. in, being above that of the main flow line, ensures that the contaminant will be forced straight to the test filter without fear of blockage through back-pressure build-up.

As a safeguard, however, the pipe run from the solids tanks is made as short as possible and is carried under a removable grating. The actual piping is made up into three-foot lengths so that it can easily be replaced, either in sections or as a whole, with no undue delay. Apart from the question of blockage this method also means that should the Prodofilm coating be scoured off at any point—and this is bound to happen through the continued use of highly abrasive test contaminants—then only that particular section and not the whole need be renovated.

Solid Contaminants

Virtually any type of solid contaminant can be introduced for testing the filters to simulate local conditions, but where this is not specified the principal medium used for the test is black magnetic iron oxide. Aluminium oxide and red oxide are also used occasionally and, to a much lesser degree, a zinc based contaminant. Whatever form of contaminant is selected, it is first mixed with kerosine to form a "slurry," so representing the normal state in which it would pass through a filter in service. A hopper feed mechanism is used for injecting the powder into the mixing tank at the base of which tangentially placed jets spray kerosine at high pressure on to the dust to form a controlled "slurry." In this state it is pumped to the test filter.

Underground Reservoir

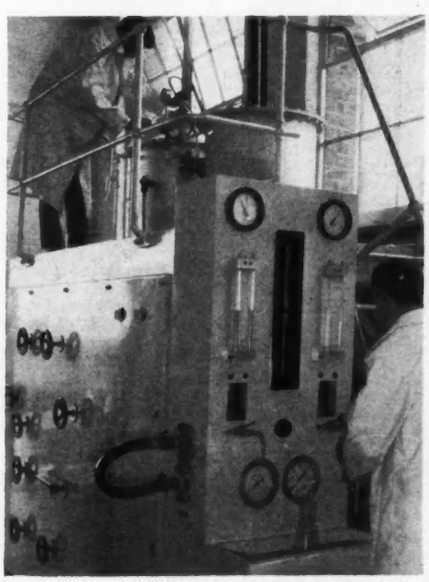
To have provided a sufficient head of water for directly operating the test rig would have necessitated laying a 4 in main over a sizeable area of Leamington. To avoid the trouble and expense of such an operation but still provide a sufficient head of water, a 1,000 gallon underground reservoir has been constructed. This is topped-up from the normal mains supply and also takes all the drainings from the various test point bunds, whether they are contaminated or otherwise.

Water from the underground reservoir is drawn off by a 100 gallons per minute Pegson pump coupled to a 10 hp electric motor and is first passed through a water extraction unit. This works in quite an ingenious fashion. Three probes placed one above the other in the upper part of the extraction tank are connected to an electrically-operated solenoid valve. After separation there is always a certain proportion of water on the top of which there is a layer of kerosine. This kerosine, being non-conductive, has no effect on the probes and therefore flows off into a backflush tank. As the level of water rises however, it eventually contacts the topmost probe and as this happens the solenoid comes into operation, opening the valve and allowing the water separately to flow away. As the level of water drops, contact is broken with the top probe whence the solenoid closes off the water valve. In this way it will be seen that the separation process is continuous. A continuous monitor is also used to indicate that there is no fuel left in the injected water.

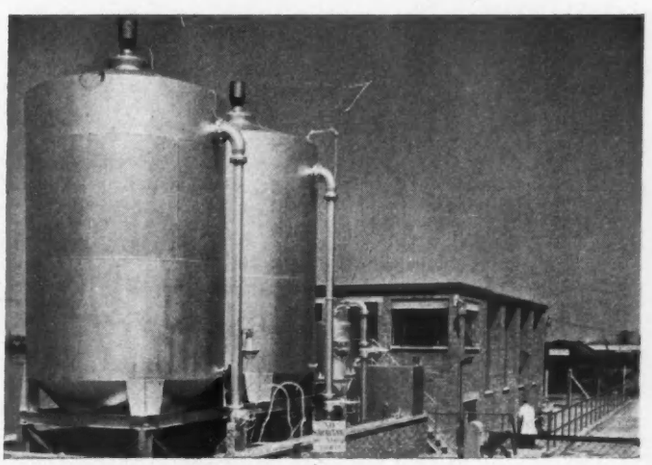
After contaminated fluid has been passed through the test unit it can be fed into a bulk fuel filter, a filter-separator or through the two; or, if it is completely free from contamination, it can then be by-passed from the filter area completely.

The complete test sequence is controlled by an operator who has a fully-equipped test panel to guide him. From this panel the operator is able to start up the main pump units, control the rate of flow, accurately meter the amount of contaminant to be fed into the test filter, check the temperature of the fluid, and switch off or by-pass any part of the test sequence at will.

A further feature of the test equipment is that everything is repeated in miniature so that tests of individual elements or small filters can be carried out in exactly the same way.



(Left) Fluid samples are taken from a panel (lower right) so that filter efficiency can be measured during tests.

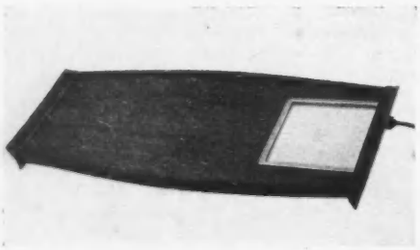


(Right) Two 8,000 gallon storage tanks, containing kerosine, have specially filtered vents so that air drawn into the tanks is dirt and moisture free.

Cooking and Keeping Hot

PRESSURE on kitchen space still continues to be acute and more combination units are shortly to be imported into this country from America. These are the series made by the Dwyer Products Corporation of Michigan City, Indiana, and include various combinations of sink, cooker and refrigerator. One of them, the model 51, is shown in the first illustration.

Smallest in the series is the 39 (the number signifies the width of the top in inches) which has two hot plates and an appliance socket outlet mounted over the 5 cu. ft refrigerator. The bowl of the sink measures 12¼ in by 17¾ in by 6½ in and stands over a storage cupboard. A two burner gas range can be fitted in place of the electric plates if desired. The floor space needed is 39 in by 26 in over the handles. Next in size is the model 51, illustrated, which has one large and two small electric plates or one large and three small gas rings. Below the sink is the oven, either with two elements rated at 4,600 watts or with gas heating, in which case there is a separate broiler below. Thermostatic control



(Upper, left) Cooker, refrigerator and sink are combined in the Dwyer range of kitchen units.

(Above) Food can be kept hot on the Salton Hotable which has a heated top tray with a special "hot spot" for the coffee pot.

(Left) Another model in the Salton range is the Viking—a walnut tray with a Hotrayette unit inserted at one end.

is fitted for both. The sink is the same size as for the model 39 and has room below it to fit a garbage disposal unit. In addition to the standard model, a version is available which has special ends to fit flush in a recess.

The series continues with models of 60 and 69 in width and for all of them there is choice of top cabinets. A socket outlet can be fitted on the underside of the cabinet if required. There are also units made up of sink and refrigerator only. The series 400 is described as a buffet kitchen; it has a sink top with two hotplates, refrigerator and large store cupboard. When not in use a lid closes over the top and meets flush with the front doors, the whole being locked by a single key. In this condition it measures 42 in high; width and depth are 48 in by 21⅞ in respectively, and it can be counted a respectable addition to a living room. The company make utility cupboards and drawer units to match with the range, and also complete combination snack bars.

Examples of the Dwyer range were displayed at an exhibition of American domestic hardware held recently at the USA trade centre in London. So also was a large choice of kitchen ware and barbecues of varying degrees of elaboration. Another firm showing items was the Salton Manufacturing Company Incorporated, 519 East 72nd Street, New York, NY. Their Hotray and Hotable ranges solve the problem of keeping food hot after cooking and before eating.

The second illustration shows one of the Hotables—The Royal Gold. The frame is gold anodized aluminium with walnut trim and handles. The lower tray is walnut coloured melamine. The hot spot under the coffee pot has a choice of two temperatures and is fitted with a pilot light. The upper heating tray is made of shatterproof glass and has an effective heating area of 25 in by 15 in. Heating rating is 1 kW and there is an adjustable control of the temperature so that the table can be used on the veranda or other "cool air" spots. The thermostat gives a range from ambient to 265° F. Models are available for either 110 V or 220 V ac. Overall, the trolley measures 28 in long by 17 in wide by 28½ in high.

An alternative model to the Royal Gold is finished in satin silver aluminium, again with walnut trim, and there is a Buffet model of slightly different design which has side flaps opening to give a surface of 48 in by 28 in. This has a chromium plated steel frame and a Fomica finished lower shelf. The Continental, another design, has a square frame of polished brass and is equipped with the standard upper heating tray of glass and a lower tray of melamine. It is particularly claimed for the Hotables that the heat is even over the surface, which can be wiped clean and does not stain.

The third illustration shows one of the Hotrays made by the same firm. It consists of a walnut tray with a Hotrayette unit inserted at one end. This design is called the Viking and measures 25 in by 11 in overall. The handles and legs are made in one piece and are claimed to be easy to hold and steady on the table. The heating area of the Hotrayette unit is 36 sq. in and its rating 120 watts. Thermostatic control is fixed for 200° F so that a coffee pot standing on it is kept nearly at the boil. The unheated walnut portion of the tray will take the cups, sugar bowl, and other serving pieces. A very wide range of Hotrays is made, both as regard style and size. Dimensions are from 8½ in to 6½ in. overall, to family models of 32 in by 16¼ in or the Smorgasbord of 52 in by 9½ in. "Hot spots" and adjustable thermostats are other features.

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